





Digitized by the Internet Archive  
in 2015

MARYLAND & RARE BOOK ROOM  
UNIVERSITY OF MARYLAND LIBRARY  
COLLEGE PARK, MD.



0.75  
366

Annual report

Maryland State  
University of Maryland Library, Md.  
College Park, Md.



**UNIVERSITY OF MARYLAND**  
**AGRICULTURAL EXPERIMENT STATION**

**RESEARCH LEADS  
TO PROGRESS OF  
MARYLAND AGRICULTURE**

**SEVENTY-FIFTH ANNUAL REPORT**

**BULLETIN A-133**

**JUNE 1963**



# RESEARCH LEADS TO PROGRESS OF MARYLAND AGRICULTURE

SEVENTY-FIFTH ANNUAL REPORT

1961-1962

UNIVERSITY OF MARYLAND  
CULTURAL EXPERIMENT STATION

BULLETIN A-133  
COLLEGE PARK  
MARYLAND  
JUNE 1963

BOARD OF REGENTS OF THE UNIVERSITY OF  
MARYLAND AND THE MARYLAND STATE  
BOARD OF AGRICULTURE  
1961-1962

CHARLES P. McCORMICK, CHAIRMAN, BALTIMORE  
EDWARD F. HOLTER, VICE-CHAIRMAN, BALTIMORE  
B. HERBERT BROWN, SECRETARY, BALTIMORE  
HARRY H. NUTTLE, TREASURER, DENTON  
WILLIAM B. LONG, SALISBURY  
RICHARD W. CASE, BALTIMORE, ASSISTANT TREASURER  
THOMAS W. PANGBORN, HAGERSTOWN  
THOMAS B. SYMONS, TAKOMA PARK  
WILLIAM C. WALSH, CUMBERLAND  
MRS. JOHN L. WHITEHURST, BALTIMORE  
WILSON H. ELKINS, PRESIDENT & EXECUTIVE OFFICER  
COLLEGE PARK, MARYLAND



UNIVERSITY OF MARYLAND  
AGRICULTURAL EXPERIMENT STATION  
COLLEGE PARK, MD.

*To The Governor of Maryland,  
the Board of Regents,  
and the President of the University of Maryland*

I transmit herewith the Seventy-Fifth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1962, and a statement of the receipts and disbursements for the same period.



I. C. Haut  
*Director*

# 75

## YEARS OF PROGRESS IN RESEARCH

This issue marks the 75th anniversary of the Maryland Agricultural Experiment Station.

Projects reviewed and those mentioned in the list on pages 89-96 reflect the steady advance of scientific and practical studies of many phases of progressive agriculture. The effort put into research has grown year by year without cease. Decisive changes in production, processing, distribution, as well as in agricultural practices and thinking, have given rise to new descriptive terms like "Agri-business."

New processes, new varieties proven in the fields, the markets, the home, the factory, and the laboratories have influenced consumer tastes, stimulated the industry, and given the farmer new horizons. Research is the mother's milk of progress.

Linking the world of ideas and the world of facts, the research worker deserves and increasingly wins recognition. The patient organizer of knowledge, the thinking technician poised on the brink of new discoveries—seeking out and presenting the truth—is in the forefront of those bringing rich gifts to mankind. We take pride in his achievements.

The findings of today are structural elements in the agriculture of tomorrow.

# CONTENTS

The project number is given after each progress report. The title of the project and the personnel associated with it can be found listed among the current projects on pages 89-96.

	Page
Presenting the Station's Five Research Farms .....	vi
Agricultural Economics .....	1
Agricultural Education .....	14
Agricultural Engineering .....	16
Agronomy .....	23
Animal Science .....	36
Botany .....	44
Dairy .....	51
Entomology .....	57
Home Economics .....	62
Horticulture .....	64
Poultry .....	69
Veterinary Science .....	79
Station Staff .....	83
Financial Statement .....	84
Publications .....	85
Current Projects .....	91

*Contribution No. 3569*  
*Maryland Agricultural Experiment Station*

Presenting—

## **The Five Research Farms Of Maryland Agricultural Experiment Station**

Five representative farms in Maryland are key factors in the research program conducted by the Experiment Station. Major agricultural research projects are centered in the fields and laboratories, and where appropriate for publishing, the findings are first subjected to field experimentation on one or more of these farms.

Projects dealing with crop production, livestock and poultry raising, dairying, and the marketing of farm products are constantly under way. Soil and water investigations, consumer tastes and demands, insect and disease control, and farm management are also of perennial concern. Assignments in many fields are given attention as needs arise, since coordination of effort is required in the many-sided agriculture of Maryland.

Each of the farms has one or several major areas of study. For example, the Tobacco Farm, in the forefront of experimentation, has helped to maintain quality and supply of the world-renowned mild tobacco of Maryland.

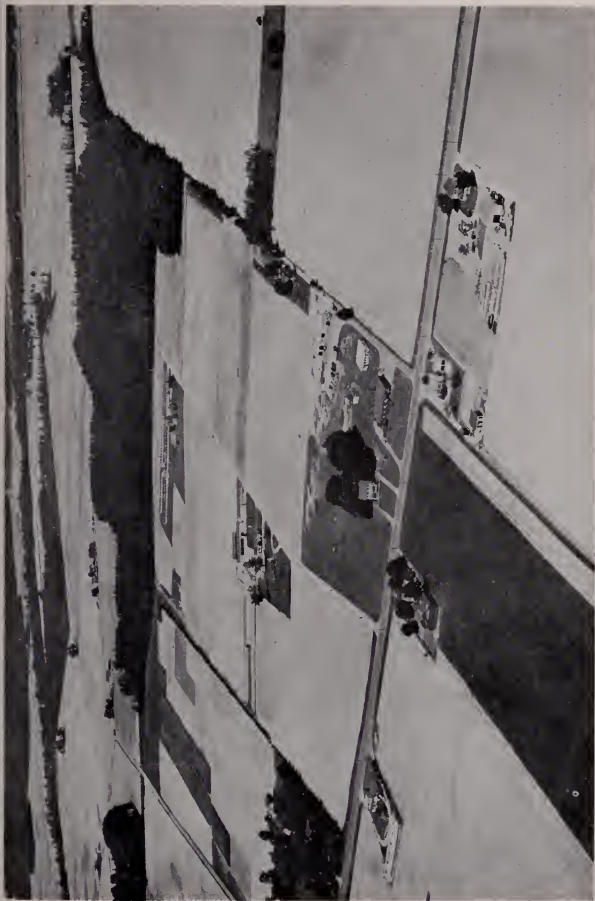
Benefits to the farmer, the processor, the marketer and the consumer are many. Out of studies at the five research farms have come such achievements as developing an agriculture geared to the land capabilities and the climate, the breeding of vigorous and disease-resistant crop plants, the production of superior poultry and improvement of livestock feeding and herd management, thereby making possible competitive standing of Maryland agriculture.



PLANT RESEARCH FARM (Hopkins-Nash farm) at Fairland. Conducts numerous field-scale experiments, including tests of varieties, cultural practices, and protection of field and orchard crops. *From 2000 feet elevation.*



ANIMAL RESEARCH FARM (Otten farm) at Waterloo, gives primacy to research in the various animal sciences, for management and improvement of livestock. This portion of farm shows headquarters and some of the fields.  
*Seen from helicopter 2000 feet elevation.*



POULTRY AND VEGETABLE FARM at Salisbury, in Eastern Maryland's Coastal Plain area. Intensive study of vegetable crops, their propagation, irrigation, culture and protection from pests and diseases is concentrated here. Also the center for applied research in broiler production. *Photographed from airplane 3000 feet elevation.*



TOBACCO FARM, Upper Marlboro. Tobacco culture and curing. These studies, in turn, include land use, fertility, management, and cropping systems.

*From helicopter, 2000 feet.*





CENTRAL FARM, at Ellicott City. This portion is site of investigations in agronomy and dairy science.

*Photographed from helicopter 2000 feet elevation.*



# **RESEARCH LEADS TO PROGRESS OF MARYLAND AGRICULTURE**

## **AGRICULTURAL ECONOMICS**

Study of Agricultural Economics is essential in approaching problems of present-day agriculture. Production and marketing require constant forethought and planning to attain the goals of efficient and harmonious functioning of the vast agricultural and industrial complex that must serve the producer, the processor and the consumer. High standards, yet a sufficient fluidity, are born of the pressure of necessity. Should greater emphasis be placed on the production of livestock and livestock products rather than cash crops? Economic thinking can help the operator to answer such questions for himself.

### **Opportunities in Adjustments in Farm Organization**

Successful farm operation to obtain satisfactory incomes for the farm family depends to an important extent on the effectiveness of decisions made and carried out concerning what combination of crops and livestock to produce and the methods of achieving this result. The most profitable organization, i.e., combination of crops and livestock, for a given farm or farmer may vary from year to year as a result of many changing forces. Primarily, these forces are changes in available resources, in price and cost relationships, in technology, and in Government policies and programs. Changes in these forces, thus, may evolve from within the farm or from without.

This study consisted of an analysis of changes over recent years and an appraisal of alternative opportunities for changing present organizations to more profitable systems of farming in Talbot County. Major changes over the last 5 years in this area, which was true to some extent in the entire State, were: (1) an increase in the total acreage per farm; (2) a decrease in number of farms; (3) a slight shift in emphasis from livestock and livestock products toward greater emphasis on crops; and (4) a shift in cropping patterns from vegetables and wheat to corn for grain and soybeans.

Alternative opportunities for increasing farm incomes were appraised in

light of conditions found from a survey of 91 farms in Talbot County. Certain characteristics of these farms may be noted in the accompanying table:

Opportunities for increasing income on these farms vary to a large extent among the three groups. Yields per acre of crops and rates of production of livestock on the small farms were only slightly below average of all farms. Thus, increases in yields offer only slight opportunity for increasing income, since the total of productive work units was low. The most promising opportunity for increasing income on these small farms appears to be in increasing the size of farm. Generally, these farms had only enough productive work to keep the available labor force profitably employed for about half the year.

Most promising opportunities for increasing incomes on the second group of farms was (1) continuous selection of enterprises with the most favorable relationship between prices paid and prices received, and (2) increase in size of business in order to reap full advantage of technology.

Adjustments needed on large farms consisted of (1) greater emphasis on production of livestock and livestock products rather than cash crops, (2) changes in size and location of enterprises to keep per unit overhead costs within reasonable limits, and (3) adjustments in farm leases and renting arrangements to encourage production of livestock and livestock products on leased or rented land resources.

(Project A-18-am)

Relation between size of farm, size of labor force, and labor efficiency, 91 farms in Talbot County, Maryland

Range	Acres per farm Average	Number of farms	Man* equivalent	Acres per man	Animal** units per man	Productive man work units per man +
2-159	86.6	41	1.60	54.1	11.4	139.2
160-319	213.7	29	2.07	103.2	23.9	263.6
320 or more	614.8	21	3.96	155.3	27.4	303.5
All farms	253.1	91	2.22	114.0	23.2	230.8

\* One man-equivalent is one average adult man or the equivalent.  
 \*\* One animal unit is one mature dairy cow or the equivalent.  
 + One productive man work unit is the number of acres of crops or number of livestock which requires one 10-hour day's work.

## Study Determines Amounts Of Input-Output Items and Cost of Producing Eggs in Caged-Layer Operations in Maryland

A study of caged-layer flocks in Maryland, averaging 1,198 birds per flock, shows that the mortality was low, averaging 6.4 percent. It also shows that the average annual rate of egg production was 217 eggs, or 18.1 dozen per layer, which was 31 eggs above the State average of 186 for 1958. The average layer consumed 87.5 pounds of feed or 4.8 pounds per dozen eggs. It required 1.3 hours of man labor for each layer in these flocks—4.3 minutes per dozen eggs.

The returns on these flocks averaged \$9,755 per farm, \$8.14 per layer and 45.1¢ per dozen eggs. The costs on these flocks averaged \$9,950 per farm, \$8.31 per layer and 46.0¢ per dozen eggs when the operator's labor was charged at \$1.01 per hour, which the operators had indicated they believed their time was worth.

Feed was the largest single cost item, averaging \$4,722 per flock—\$3.94 per layer and 21.8¢ per dozen eggs—accounting for 47.5 percent of the costs. Depreciation on the flock was the second largest cost item, amounting to 19.0 percent of the total costs. Labor costs amounted to 15.7 percent of the total costs; and the three items—feed, flock depreciation and labor—accounted for 82.2 percent of the total costs.

The complete costs and returns data for these flocks are shown in the accompanying table.

The amount of variation on the cost and return factors indicates that the efficient poultry producer, using the caged-layer method, can operate with considerably more efficiency than the averages for these flocks.

*(Project A-18-an)*

Costs and Returns for Caged-Layer Flocks

Item	Average costs and returns	Dollars Per layer	Cents per dozen eggs	Percent of total costs and returns
<b>COSTS:</b>	dollars	dollars	cents	percent
Feed	4,722	3.94	21.8	47.5
Depreciation on flock	1,889	1.58	8.7	19.0
Labor	1,562	1.30	7.2	15.7
Buildings*	637	.53	3.0	6.4
Equipment	486	.41	2.2	4.9
Electricity	212	.18	1.0	2.1
Tractor, truck & auto	143	.12	.7	1.4
Interest on flock	100	.08	.5	1.0
Other	199	.17	.9	2.0
<b>Total</b>	<b>9,950</b>	<b>8.31</b>	<b>46.0</b>	<b>100.0</b>
<b>RETURNS</b>				
Eggs	9,442	7.88	43.6	96.8
Layers sold and eaten	229	.19	1.1	2.3
Miscellaneous receipts	84	.07	.4	.9
<b>Total</b>	<b>9,755</b>	<b>8.14</b>	<b>45.1</b>	<b>100.0</b>
<b>Loss</b>	<b>195</b>	<b>.17</b>	<b>.9</b>	

\* Does not include a charge for the building site nor taxes.

## Silage Harvest and Storage

The silage storage and silo data from 87 Maryland farms were tabulated and summarized. Experiences with both grass and cow silage were studied. Thirteen of the eighteen farmers who made grass silage used the direct-cut method, and the other five permitted the grass to wilt after it was cut.

Where corn or direct-cut hay crop silage was made, the most common labor crew and machinery combination consisted of three men, three tractors and two self-unloading wagons. Where

dump trucks were used in place of wagons, the most common crew contained four men, three tractors and two trucks. However, there was considerable variation in the men-machine combinations used in silage harvest from farm to farm. The time required to harvest and store corn silage with a forage harvester averaged 90.6 minutes per acre with wagon hauling and 61.2 minutes per acre with truck hauling.

*(Project A-18-ao)*

## Effects of Vertical Integration on Broiler Growers' Incomes

Advantages or disadvantages which may accrue to broiler growers and other farm producers by entering into contracts with off-farm suppliers and purchasers have been considered and discussed on a relatively wide scale. Two aspects of vertical integration or contract farming which have not been treated or discussed as much as some others were investigated in this study. These were: (1) the effects of vertical integration on variability of income as well as average level of income and (2) the relationship between advantages of vertical integration and level of efficiency of growers. As a means of studying these aspects of vertical integration, expected returns to growers over the period 1948-1961 under 10 different financing plans were examined and compared.

Under existing price relationships over this period, a grower with a feed efficiency of 2.5 would have earned a greater average income per 1,000 broilers started over this period under a self-financed plan than with any contract plan considered. However, the net returns under this plan would have been much more variable than under

off-farm financing plans. In some cases, self-financing would have resulted in a negative return on grower-furnished items. Therefore, the most desirable financing plan for a specific grower, assuming he could finance his own operations, depends on his willingness to sacrifice returns in some years to gain more stability in income. This willingness undoubtedly depends on the individual grower's asset position, his propensity to take losses in some years with expectation of making larger gains offsetting poor gains in other years, and other factors.

Of plans studied, a grower with a feed conversion of 3.5 (relatively low efficiency) would have earned the greatest average net returns over the same period by contracting at \$35 per 1,000 plus  $\frac{2}{3}$  of calculated profits. This plan also would have resulted in relatively low variability in income. At this level of feed efficiency, most contract plans would have been more desirable from the standpoint of both average net returns and variability in net returns than grower-financed plans.

Results of this study point out two important additional aspects of vertical

integration. First, broiler growers should give some attention to expected results of various financing plans with regards to variability in income. Secondly, off-farm financing dealers may want to

change their contracts to make them more attractive to highly efficient growers than to those with rather low efficiency.

*(Project A-18-aq)*

## **Large Dairy Farms**

Forty-four large dairy farms, ranging in size from 90 to 400 cows, were visited and data were obtained on farm organization and operation for the 1960-61 year ending April 30. These farms averaged 5.8 man-equivalents per farm to handle an average of 147 cows and 302 crop acres per farm. The average labor intensity on these large farms was 52 crop acres and 28 cows plus replacements per worker.

These large dairy farms had average annual milk sales of \$57,390 per farm and \$11,505 per worker. The average milk sold per cow was 8,006 pounds, which resulted in average gross receipts from milk of \$408 per cow.

Pounds of milk produced and sold ranged from one-half million to 2.7 million pounds per farm, with an average of 1.1 million pounds per farm. Weight of milk sold was nearly 1,800 pounds per cow lower on these farms than found on a similar study made in 1959-60. This indicates some loss of production efficiency per cow as the number of cows per herd is increased although more cows are handled per worker.

These data and their underlying relationships will be useful to dairymen who are planning to expand the size of their dairy farm operation.

*(Project A-18-ar)*

## **Farm Prices Analysis**

This project was activated this current fiscal year. Data on annual Maryland farm product prices from 1910 to 1959 have been tabulated and summarized for selected farm commodities. Five, ten, twenty and thirty year averages have been calculated for annual average prices of major farm products produced on Maryland farms. These data will be useful to managers of farms considering enterprise adjustments.

The preliminary results of this price-analysis project indicate that there has been some reduction in the seasonal price variation patterns during recent years in both crop and livestock products. The more uniform flow of farm products to market during the entire year has been the major factor causing this reduction in seasonal price variations.

*(Project A-18-as)*

## **Acquisition and Use of Capital on Large Farms**

Three of the adjustments in resource use taking place in agriculture today are; an increase in the use of capital, a decrease in the amount of land being used, and a decrease in the size of the farm labor force.

Increased capitalization on farms has taken place at a rather rapid rate with the increasing size of the farm business

accompanied by larger investments in farm machinery and livestock.

As a result of these shifts many farms today have rather large capital investments. The county agricultural agents have identified 829 Maryland farms which they believe represent investments of about \$100,000 each.

Most farm management studies deal

with the "average" farm and as a result little is known about these larger farm businesses. A study is now in progress to determine how the operators of large farm businesses obtained the capital now being used in their businesses, how this capital is invested in

the farm businesses and the rate of return on capital. This study will also reveal farmers' opinions as to the availability and adequacy of farm credit for financing large farm businesses.

*(Project A-18-at)*

## **Dairy Farm Adjustments and Supply Response in Northeast**

The supply of dairy products is causing increasing concern in agriculture. It is the purpose of the study to investigate the magnitude of future dairy adjustments and the aggregate supply response to be expected in Maryland under different economic conditions. A total of 148 schedules have been obtained from a sample of Maryland farmers in 6 counties. Data from the schedules relating to farm resources

and practices will be used in the linear programming models used to determine supply response under alternative conditions. The data are currently being tabulated and benchmark farms established. The results will be useful in advising farmers and other interested groups of the supply response expected under alternative conditions.

*(Project A-18-au)*

## **Progress Seen In Relating Tax Ability and County Functional Support**

Economic data as criteria for measuring ability and effort for county functional support in Maryland have been improved substantially in recent years, especially by facts developed from the 1960 U. S. Censuses of population and housing. However, available data still lack the completeness and comparability necessary for precise indexes to determine fiscal sharing by the State and counties.

Several types of data, such as total personal income and real estate tax assessed values (especially residential plus farm real estate) indicate, for example, that Montgomery County had, in 1960, about 40 times the tax capacity or resources as did Garrett County. However, the amount of state taxable income, and consequently state income tax collection, was about 100 times greater for Montgomery County than for Garrett County. Higher employ-

ment density, especially among married women, and higher wages and salaries are the major factors which result in average family incomes and personal incomes of nearly three times as much in Montgomery County as in Garrett County.

Despite tax rate increases in major state levies during the last 10 years, property taxes continue to represent about 42 percent of state and local tax collections. Existing state tax sharing with counties has not proved so successful in holding down property taxes. For example, state-shared taxes allocated to Frederick County increased about 80 percent from 1952 to 1961, whereas county property taxes increased 150 percent. For Montgomery County, state-shared taxes about tripled during the 10 years, but property taxes rose nearly 270 percent.



The more commonly known formulated programs of state financial participation in county functions result in a much greater relative subsidy to the poorer counties. However, a considerable amount of state financial participation, such as for higher education, secondary state highways, teacher retirement, and state institutional support, is not on a formulated basis but

is directly or indirectly the support of functions on account of, or beneficial to, residents of the respective counties. These state participations together with recent state allocations of a state-wide revenue on a population basis may, to a considerable extent, be counterbalancing factors in favor of the more wealthy counties.

*(Completed Project A-19-w)*

## **Agricultural Use Value Concept Under Study**

In cooperation with the Economic Research Service of the U. S. Department of Agriculture, inquiry by questionnaire has been made of land tract owners in two election districts near the suburban area of Montgomery County, Maryland. This inquiry covers information concerning farm operations and outlook of farm owners, where subdivision growth pressures keep farm real estate values on the rise. Data on such farms, and the farm

enterprises, have been obtained on about 200 farm tracts, and the results will be available in a forthcoming report. The facts developed from this survey should give guidance for administering the recent agricultural use land tax assessment law of Maryland, and indicate the behavior of farm owners under the impact of higher land use potentials with special reference to application of the agricultural use land tax. *(Current Project A-19-y)*

## **Competitive Position of Maryland Soybeans**

Maryland soybean growers have demonstrated their decision to produce more soybeans at prices no higher than in the Midwest, and at prices which tended to decline over the period studied. These prices declined more for soybean oil than for meal.

Domestic markets for soybean meal have absorbed vastly increased supplies, especially for poultry and hog feeds. Prices for soybean meal have not fallen over the years as much as prices for oil. Moreover, prices of the meal are much higher in Maryland than in the Midwest.

Domestic markets for soybean oil have utilized the expanded supplies for the manufacture of margarine, which has displaced over half of the per capi-

ta consumption of butter. In addition, soybean oil has been used in the manufacture of shortening, because the supplies of alternative fats and oils are not so easily increased. The search for oil to fill the increased demand for these end products and for their component materials was centered on soybeans.

Maryland needs more than soybean meal, but not oil; yet, shifting back to soybean varieties of lower oil yield per bushel would not help; it would hurt financially. Sacrificing a pound of oil to gain a pound of meal would be like trading 10 cents for 3 cents. One alternative is to enlarge soybean processing facilities to produce meal nearby, so as to narrow the margin of

about \$15 a ton between Midwest and Maryland prices for the meal at wholesale. However, questions concerning markets for the additional quantities of soybean oil, which are jointly produced with the meal, inevitably pose price

problems for soybean growers and processors. A more rapid development of export markets for the soybean oil could help to check the widening spread between prices of meal and oil.

*(Project A-26-az)*

### **Canned Vegetable Quality Factors at Stages of Marketing**

When procuring and processing vegetables, canners aim for a product that will meet the quality factors considered to be important by their food-firm customers. Likewise, food retailers must satisfy consumers' wants with reference to quality. In this study, the quality criteria of these three groups were studied and compared in order to indicate ways in which processors

might more nearly meet requirements of the food trade.

In judging the overall quality of unlabeled cans of two different grades of tomatoes and green beans, canners and distributors graded the tomatoes about equally, but canners were more critical in scoring the green bean sample. On the basis of the appraised price differential between two grades,



Testing, comparing, and grading foods for qualities that will satisfy consumer wants. Results of tests enable processors to meet requirements of foods. Consumers and processors in a recent evaluation agreed closely on most vegetables except green beans, about which the canners were declared more critical.

distributors tended to set a greater price difference than did canners.

Flavor of both canned beans and tomatoes was considered to be a more important quality criterion by consumers than by canners or food firms. Consumers differed from the other groups, also, in ascribing more importance to wholeness of tomatoes, but less to color. Maturity of green beans was scored higher as a quality criterion by canners than by distributors.

An earlier phase of the study was concerned with vegetable canners' practices in controlling and differentiating quality of both the raw and processed

product. In obtaining tomatoes for processing, control over raw-product quality was limited by the fact that more than one-half of the processors bought their tomatoes on the open market, and about two-thirds of the firms paid for tomatoes on a flat price rather than on graded basis.

Due to the diversity of quality regulating and inspection practices canners believed government grading should be adopted, if canners were to develop a group-marketing organization as a means of pooling and selling their products to large-scale buyers.

*(Project A-26-ba)*

## **Study of Livestock Terminal Market**

A study made of the Baltimore Public Stockyards, the only terminal facility in Maryland and the largest on the eastern seaboard, showed trends of livestock volume receipts. Although data presented in the study portray a general downward trend in livestock receipts at the terminal market, there were indications of strength in certain aspects of the market for the future.

Receipts of cattle and sheep, supported by an upward trend in transit shipments, would help maintain total receipts at comparatively high levels. Slaughter plants now operating in close proximity to the stockyards, some of which have plans for expansion, are considered a favorable factor for the growth of this market. The position of the Baltimore Public Stockyards, in relation to other market facilities, will depend to a large extent on successful promotion among producers of the advantages of terminal selling. The physical convenience of the Baltimore terminal market to Maryland livestock



Baltimore Public Stockyards is a convenient facility of the Baltimore terminal market. Over 8,000 producers and shippers were consignors here last year.

# APPROXIMATE DISTRIBUTION BROILER-FRYERS MAJOR BROILER AREAS TO MAJOR CITIES 1961



Chart prepared by Delmarva Poultry Industry, Inc., shows where the broiler production from major areas is marketed. Delmarva growers generally have higher labor and feed costs, raise a heavier bird, and receive a higher average price for their birds than do most broiler areas, as shown by recent survey.

producers has been improved by the recent development of superhighways opened to truck transportation.

The peak months for marketing at the terminal were August, September, and October for cattle and calves; March, April, and May for hogs; June, July, and August for sheep and lambs. Daily receipts were heaviest on Monday and Thursday. The number of consignors to the terminal market

was 8,400 individuals and firms of which 6,200 were Maryland users. The states of Virginia, Pennsylvania, and West Virginia also made extensive use of this market.

Findings as a result of this study were correlated with specifications for buying of meat in this area. Results of this and other aspects of the project will be reported at a later time.

*(Project A-26-bb)*

## **Market Orientation Vital to Broiler Industry**

Nearness to market continues to be an important factor contributing to the expansion of the Maryland broiler industry. Markets for the Maryland product, as indicated by an orientation study, were concentrated in New York, Philadelphia, Boston, and Pittsburgh, with smaller cities in New Jersey, Pennsylvania, and upstate New York also being important receivers. No other commercial area had this advantage, as shown in the chart below.

The Maryland broiler industry has had a growth rate of 4.3 million head per year in the last decade. Much of the expansion was attributed to a higher price for whole, ready-to-cook, Grade A poultry. Maryland processors consistently received a higher price for Grade A than other major broiler areas during the nine-week period studied. These higher prices enabled processors to pay contractor-growers higher prices for live birds and, as a consequence, encouraged continued expansion of the industry.

Other phases of the study showed Maryland producers had higher costs, due to higher freight rates on feed ingredients and higher returns to labor in the form of larger incentives to growers in this area and higher wages to workers in processing. Other phases of the study, including sources and prices of raw materials and comparisons of productivity and efficiency ratios, clearly point to the fact that Maryland can continue to be competitive with the Southeast, assuming the area can maintain its advantages due to market orientation.

The competitive-position study of the broiler industry, in pointing out inequities in transportation, led to a reduction in the freight rate of 70 cents per ton, which led to substantial savings to the industry. Other proposals for freight rate reductions are being considered and may result in placing Maryland in a slightly more favorable position on transportation rates.

*(Project A-26-bd)*

## **Variable Daily Volume Adverse to Labor Efficiency In Tobacco Auction Warehouses**

By means of the ratio-delay method, four of the eight tobacco auction warehouses in southern Maryland were

studied during the 1961 marketing season. Results of this study clearly show the adverse effect of variation in vol-

ume on labor utilization in the warehouses. It was found that total sales volume during the 11th week of the selling period was only 36 percent of the volume sold during the second week of the marketing season. This variation in the quantity of tobacco moving through the auction warehouses sharply reduced the proportion of labor time spent in productive effort. Warehousemen are highly competitive with each other in their efforts to maintain or increase the quantity of tobacco handled on each floor. As a result, it is necessary to maintain a sufficient labor force at the warehouse to unload farmers' trucks expeditiously; and hence, there is idle time even when the markets are operating at their maximum allotment early in the season.

Some warehousemen have a more flexible labor policy than others and, thereby, attempt to adjust the number of workers somewhat to the volume of tobacco handled. Furthermore, the sales volume tended to fall off more rapidly in some warehouses than in others. For the group as a whole, the percentage of time spent by warehouse employees in receiving, weighing, and placing tobacco on the auction floors ranged from 62 percent to 34 percent, thus indicating that floor labor could be much more effectively used if the sales volume received during the early weeks of the season could be maintained until the entire crop was sold.

The influence of the planting season, which occurs while the auction markets are open, was clearly demonstrated. The lowest volume of sales and the least efficient use of warehouse labor occurred during the weeks when farmers were busy planting their next year's crop and, consequently, were unable to bring tobacco to market.

The adverse effect of volume changes on labor utilization was even more clearly demonstrated in connection with the employees engaged in office work. The custom here was almost universally to maintain the same staff practically to the end of the marketing season. Thus, the total daily hours of labor in the office force was maintained almost constant throughout the entire marketing period, and the percentage of time at work varied even more sharply than was the case with warehouse labor.

This study clearly indicated that the labor available to southern Maryland warehousemen could have handled the total crop in approximately  $\frac{2}{3}$  of the time if volume of sales could have been maintained at a rate as much as 85 percent of the first two weeks. Thus, the custom of selling Maryland tobacco in 12 weeks which could have been handled by the same labor force in 8 weeks increases the labor cost of marketing Maryland tobacco by at least one-third.

*(Project A-26-bf (ES 699))*

## **Impact of Farmer Cooperatives on the Agricultural Economy**

With an increase in the size of many farm operations in Maryland there is a wide difference in the use which farmer patrons make of their cooperatives. It is a common belief among many persons, both farm and non-farm, that farmer cooperatives are intended

to serve only "small farmers." In Maryland, several of the leading agricultural commodities are marketed largely through cooperatives. Cooperative purchases of feed, seed, fertilizers and farm supplies have increased greatly in recent years. This study is being con-

ducted to determine the impact of farmer cooperatives on the agricultural economy of Maryland.

Data are being collected from all cooperative sources in Maryland in an effort to measure the total dollar volume of all cooperative marketing, purchasing, and service activities in Maryland. This will be compared with available data on total farm business activities in Maryland in order to ascertain the importance of farmer cooperatives.

One phase of this study includes an analysis of some of the business policies of farmer cooperatives in relation to large-volume users. An effort is being made to determine what, if any,

special arrangements are made by Maryland cooperatives to accommodate farmers who require large volumes of farm supplies.

This study was designed to determine the contribution of Maryland farmer cooperatives to the agricultural economy of the state and to determine what efforts cooperatives are making to serve the larger farm operators.

The findings of this study should help the farm as well as nonfarm public to better understand the value of farmer cooperatives to agriculture and to the general economy.

*(Project A-26-bg)*



# AGRICULTURAL EDUCATION

Agricultural education research is designed for helping leaders in agriculture work in raising the educational level of rural youth and adults. As information grows, the methods of passing on the benefits of knowledge and experience will need to be changed to meet new conditions. More and more accurate information on patterns of human behavior should be studied.

## **Training of 4-H Club Leaders**

The use of local leaders is a valued concept held by county extension personnel. Effective leadership is an essential element of community organization that links the public with agencies which promote change. The Maryland Cooperative Extension Service does much of its teaching with the assistance of local 4-H Club leaders. The success of club work depends heavily upon the effectiveness of leaders.

As the program continues to develop and more activities for youth are included, the necessity of involving more leaders will become more pressing. Experienced county extension workers recognize that they must work through local leaders in conducting activities

reaching an increasing number of youth. Likewise, it is recognized that effective leadership can be developed.

The nature and extent of training received by local leaders from county Extension staff members have not been established. Data will be collected and analyzed, indicating the training received by leaders from county Extension staff members. These will be useful to extension administrative personnel in providing a basis for planning training programs for the development of desirable attitudes, understanding, and behavior appropriate for 4-H Club leaders and county extension staff members.

*(Project F-8)*

## **Study of Agriculture Student Body**

Demand for College of Agriculture graduates by agricultural businesses, educational institutions, governmental agencies, and other employers of professional agriculturalists exceeds the supply. Information regarding student characteristics and the behavior of students attracted to the College of Ag-

riculture for preparation for employment in fields of professional agriculture should be helpful in the selection and development of students. Knowledge of the levels of intelligence and understanding possessed by students entering professional preparation and identification of subject-matter areas



causing students difficulty in their college studies may be of assistance in planning curricula within the College of Agriculture.

During the past 2 years, research has been conducted to determine College of Agriculture students' place of residence, agricultural experience, educational backgrounds and intelligence and achievement levels. Also, reasons why many academically able students discontinued their study in the college were investigated. University student records and individual students were the sources of data.

The place of residence, and student intelligence and achievement levels resembled that of the University student body as a whole. Most College of Agriculture students lived in the more populous counties, and had gained little or no farm experience. They were graduates of high schools which had graduating classes greater than 200. Based on rank in graduating class, students entering the College of Agricul-

ture during the 2-year period were slightly above average. Compared to the University student body, College of Agriculture students compared favorably with total University freshman classes except that on entrance-examination scores they earned significantly lower A.C.E. scores.

Based on available data, the number of students with demonstrated scholastic ability who failed to complete their education for nonacademic reasons was equal to the number who failed to maintain college academic standards. The most frequently reported reason given by able students who withdrew from the College of Agriculture was a lack of sufficient funds to pay for college expenses. Going to work, lack of a sense of belonging, and lack of interest in their studies were given by 10 per cent or more of the respondents as reasons for failing to complete a college education. More than half the withdrawees indicated they planned to continue the study of agriculture at the University of Maryland at a later date.  
*(Project T-6)*

# AGRICULTURAL ENGINEERING

In the application of engineering to agriculture one important phase is mechanization. The improvement of existing machines, the development of new machines, and the determination of basic data from which such machines are designed are important functions of Agricultural Engineering research. This activity is aimed at reducing labor and cost of production, maintaining quality of product, facilitating the handling and moving of crops and speeding up the work for more timely harvests. Mechanization of research itself in this and other departments of the Agricultural Experiment Station is an important function of the department.

## **Production, Harvesting and Curing of Maryland Tobacco**

**Tobacco housing.** With the foremost demands being for mechanization and improved curing of Maryland tobacco, basic studies on compact curing were continued. The quality obtained from these tests was satisfactory and indicated that the program should be expanded into a semifarmer operation.

Air rates of approximately 5 cfm per plant proved to be satisfactory. This study did indicate that the plants can be placed as close together as desired. However, the stalk should remain in a fixed position during the curing period. The position of the stalks should be with the butt up, in this position the direction of airflow can be either upward or downward. If the plants are placed butts down the tops will tend to "cabbage" which would tend to prevent uniform airflow, and damage will occur to the tobacco.

Chemical analysis did not indicate total nitrogens between compact and differences in protein nitrogen and

natural curing. Duration of burn test indicated no difference in method of curing.

Results of studies on modifying the natural conditions in conventional barns indicate the dollar value of the tobacco can be increased. This increase was greatest for the large broadleaf varieties. The broadleaf varieties have the inherent characteristics of being susceptible to "houseburn" and damage during curing. By modifying the conditions this problem can be solved, making the use of the higher yielding varieties more desirable.

Two varieties were tested: "Catterton," the popular medium broadleaf, and "Wilson," a good broadleaf type. Each was grown with 90 lbs. of available nitrogen per acre. For both varieties there was an increase in yield and dollar value for the modified curing condition over the conventional, as shown in the following table:

## Yields of 2 tobaccos under different cures

Variety	Conventional cure		Modified cure	
	Catterton	Wilson	Catterton	Wilson
Yield lb. acre	1232	1767	1288	1835
Plants acre	6223	5700	6223	5700
Value \$/100 lb.	\$72.28	\$65.07	\$72.51	\$72.67
Value \$/acre	\$890.49	\$1149.79	\$933.93	\$1333.49

*(Project RB-11-g)*

## Pneumatic Handling of Chopped Forage

Investigations were continued with an experimental system designed to convey partially cured, chopped hay into a hay drying chamber by a high-velocity stream of air. The objective of this project is to determine the design criteria for a pneumatic system for transporting wilted chopped hay in a horizontal pipe.

Tests were made using a 14-inch diameter pipe and an air delivery rate of 4300 feet per minute with zero rate of material. A total of 178 tests were run at rates of 5.0, 7.5, 10.0, 12.5, 15.0 and 17.5 tons per hour and four moisture ranges; 30%-35%, 35%-40%, 40%-45% and 45%-50%.

Data obtained were compared with previous tests made with air-delivery rates of 3,000 and 5,000 feet per minute. The data showed for a given moisture content that the air velocity decreased as the rate of material was increased. The moisture content within the range used for the experimental tests had little effect on the relationship between the rate of material conveyed and the air velocity in the sys-

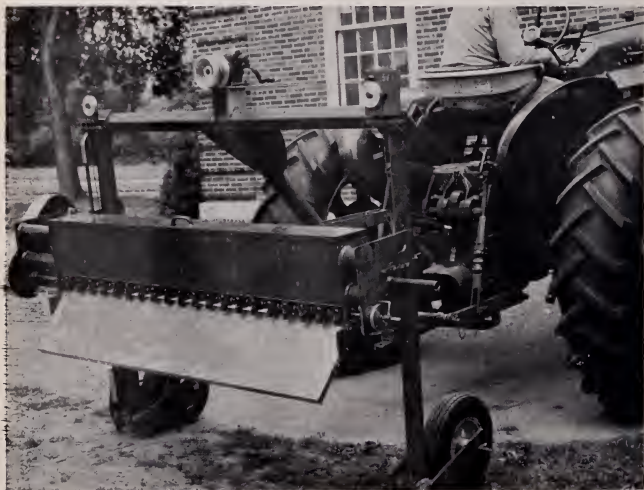
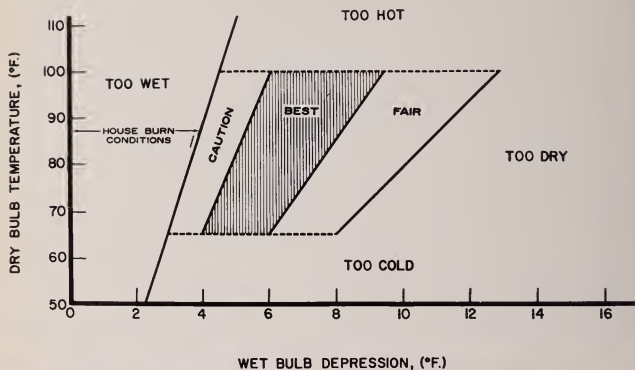
tem. The friction losses in the experimental system increased as the rate of material conveyed was increased.

Studies of the high-speed movies taken of the material during a test run confirmed what had been observed during the investigations. The material does not remain uniform within the pipe even though it enters the air stream uniformly. Slugs of material approximately 2 feet in length and varying from 4 to 6 feet apart, filled approximately 75 percent of the pipe. Between slugs very little material was observed and most of it was in the lower half of the pipe. The average velocity of a slug was determined to be 2950 feet per minute with the air-delivery rate of 4300 feet per minute with zero rate of material.

If pneumatic systems for handling chopped hay can be made practical, they will be very valuable to the farmer, because they will not only reduce labor costs but will also reduce the cost of curing in a dryer, as with baled hay.

*(Project R-16)*

# CURING CONDITIONS FOR MD. TYPE 32 TOBACCO



Constant and variable rate applicator for granular herbicide. It has adjustable wheel tread and is adjustable vertically. Has three-point hitch or standard drawbar.



Machine-harvested sweet potatoes at right are from vine-covered row.



Sweet potatoes on elevator of mechanical harvester. Note spread and depth of potatoes as well as mass of fine roots.

## Improved Methods and Equipment for Harvesting Sweet Potatoes

Sweet potatoes were experimentally harvested with a mechanical harvester described in a previous report. The separating mechanism, soil from potatoes, was of the vibratory conveyor type with a  $\frac{3}{4}$ -inch amplitude.

Centennial, Gold Rush, Nugget and Nemagold varieties were machine harvested in sandy soil. Nemagold pota-

atoes were also machine harvested in heavy soil. As a check they were conventionally harvested (plowed out and hand "scratched") in sandy soil. Potatoes in individual plots were scored for damage after 5 weeks storage with 10, a perfect score, indicating no damage.

### Results

Scores for Sweet Potatoes Harvested under different speeds and Vibration Rates

Score	Variety	Frequency	Ground speed
8.61	Centennial	600	1½
8.23	Gold Rush	600	1½
8.10	Nugget	600	1½
7.46	Nemagold	Conventional harvest	
7.29	Nemagold (Heavy Soil)		1
7.22	Nemagold		1½
7.10	Nemagold		1
6.89	Nemagold		1½
6.67	Nemagold	600	1
6.66	Nemagold	600	1
6.16	Nemagold	400	1

(Project R-18)

### Principles of Separating Soil From Root Crops

Early crop Irish potatoes were harvested in both light and heavy soil under extremely dry conditions with the potatoes well matured. A horizontal rubber-covered traveling digger chain with vertical vibration was used to provide separation.

In sandy soil speeds of 2 and 3 miles per hour, vibration frequencies of 240, 480 and 720 cycles per minute and design amplitudes of  $\frac{1}{8}$ ",  $\frac{1}{4}$ ",  $\frac{3}{8}$ " and  $\frac{1}{2}$ " were used in all combinations. Under the extremely dry conditions the soil was quickly eliminated so that only the potatoes and vines remained on the separator. Scores of the various tests

showed there was little damage and no significant difference between treatments under this wide range of conditions.

In heavy soil at speeds of 1 and 2 miles per hour, frequencies of 240, 480 and 720 cycles per minute and design amplitudes of  $\frac{1}{4}$ ",  $\frac{3}{8}$ " and  $\frac{1}{2}$ " there was again no significant difference in damage done. Hard clods were not removed under any of the treatments. Separation of the soil from the crop was not quite complete at the higher forward speeds and lower amplitudes and frequencies.

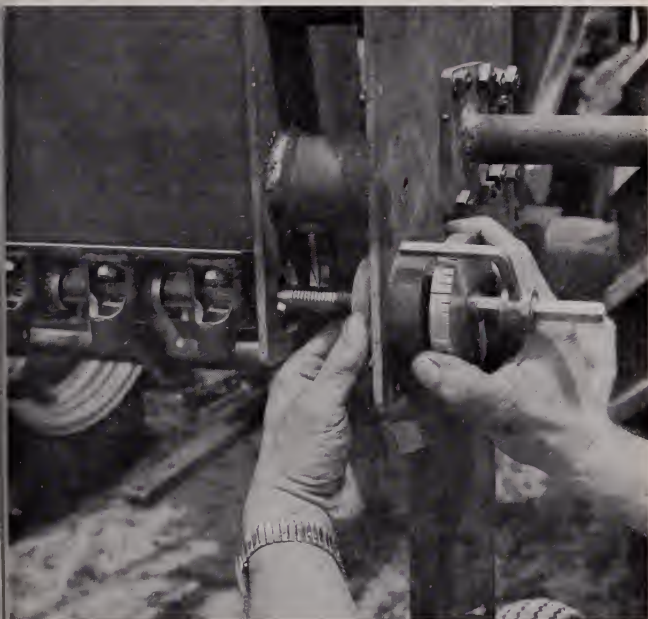
Fall crop Irish potatoes and sweet



potatoes were harvested using a vibratory conveyor type separating mechanism equipped with rubber-covered bars.

Irish potatoes were harvested at 1 and 2 miles per hour with elevator chain speed of 100, 150, 200 and 250 percent of ground speed. Abrasive damage was very uniform and very light through the tests. Because of the turgid condition of the potatoes some cracking occurred. Statistical means would indicate some advantage for the higher ground speed and lower chain-to-ground speed ratios, but there was no significant difference.

Due to the greater depth at which sweet potatoes grow it is necessary to handle a much larger volume of soil than with Irish potatoes. This means lower forward speeds and more agitation to achieve complete separation. Centennial, Gold Rush and Nugget could be harvested without severe damage. The more tender skinned Nema-gold suffered rather severe abrasive injury. Careful examination showed lines parallel to the long axis of the root. These were caused probably by sliding on the bars of the separating mechanism.  
*(Project R-20)*



Precision constant rate control for granular herbicide applicator. Each minor line represents .002 inch of travel of feed mechanism.

## Specialized Facilities and Equipment for Use in Research

Besides many minor items of assistance to various departments, a number of major items were designed and constructed.

A number of additional large calipers were built for the Animal Science Department to be used in measuring animals.

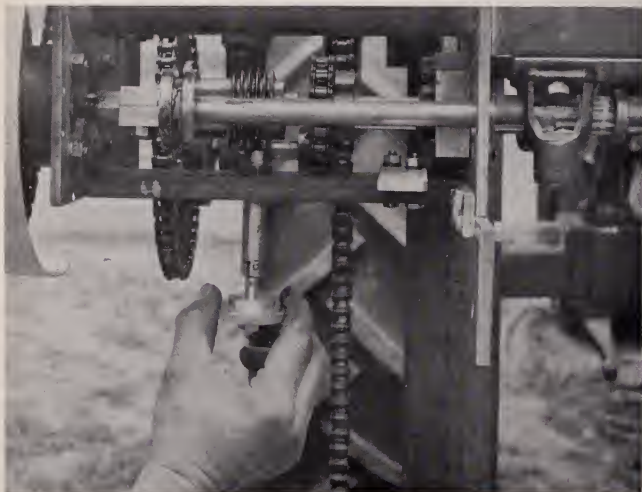
Items ranging from gas manifolds and special lights to electronic controls were designed and constructed for use in algae culture by the Botany Department.

Largest single item constructed under this project was a constant varying rate applicator for granular herbicide research. When used as a varying rate applicator the constant-rate nuts are backed off so as to disengage this mech-

anism. The feeding mechanism, consisting of fluted wheel cloverseed cups, is closed and a pin dropped into a thread. The driving sprocket is turned until the pin is perfectly seated. In 90 feet of forward travel the seed cups gradually advance to the full-open position. Rate of application is linear with distance from the starting point.

For use as a constant-rate machine the pin for variable rate is locked out and the control nuts for the constant rate are engaged. Settings can be easily made within .002 inch. With the linear relation between cup setting and output, calibration for any given rate is rapid and repeat settings are accurate.

*(Project R-21)*



Variable-rate mechanism for granular herbicide applicator. Moves uniformly from closed to full open in 90 feet for rapid evaluations of unknown materials.



# AGRONOMY

The research program in the Department of Agronomy is designed for the development of improved crop varieties and better soil and crop management practices. To accomplish these goals, research work of a basic and applied nature is conducted by the workers in the Agronomy Department. The basic research provides information essential for progress in soil and plant science over a long period, whereas the applied research helps to provide answers to problems of an immediate nature.

The reports that follow indicate the scope of the research work in progress.

## **Recent Advances in Soil Classification**

Maryland soils have been placed tentatively in a new comprehensive system of soil classification. The new system is designed to show kinds and degrees of differences between soils and their environments. In the lowest category, Maryland soils are classified in about 225 soil series. It is rather remarkable that the 225 series are distributed among 6 of the 10 classes of the order category; the highest category of the system. This indicates that over half of the broadest kinds of differences known

to exist between the soils of the world are present within Maryland.

On the other hand, marked similarity among many of the soil series is also revealed by the new system. Approximately one-third (66) of the soil series were placed in one class (normochrults) of the Great Group Category. Proper classification of the soils of Maryland will facilitate the making of sound decisions about soil use and management.

*(Project 0-48)*

## **Co-op Soil Test Studies**

The E.D.T.A. Limestone Test developed at the University of Maryland has been studied by a correlation group involving USDA and the following universities: Pennsylvania State, Cornell, University of Massachusetts, Ohio State, and Maryland. The test results are expected to depict the action of

different ground limestones in soil. It has been found that this test gives a good indication of the reactivity of the ground limestones in soils for an immediate reaction period (6 to 12 months). Further periods of reaction have not been studied.

*(Project 0-55)*

## **Rotation Plots With High Soil Aggregate Stability Have Weakest Soil Crusts**

The relationship between the breaking strength of 1/2-inch briquets (crusts made in the laboratory) and soil aggregate

stability was determined on soil samples taken in 1960. The rotations were established in 1952, and large dif-

ferences in soil aggregate stability had been established at time of sampling. The strength of the briquets was inversely related to the aggregate stability, with the strength decreasing as the aggregate stability increased. The cropping systems that had the highest soil

aggregate stability were those that included grass and hay in the rotation. The systems with the lowest stability were those requiring frequent plowing, such as continuous bare fallow, continuous soybeans and continuous corn.

*(Project 0-56 (NE-11))*

### **A Study of Ammonium Fertilizer and Ammonium Retention in Soils**

The reduction of potassium and ammonium fixation by the incorporation into the soil of various organic materials was found to vary with time of incorporation and type of organic material. Evidence indicates that some of

this reduction is due to actual organic compounds and not to potassium and ammonium additions resulting from the decomposition of the organic matter.

*(Project 0-57 (NE-39))*

### **Potassium-Nitrogen Balance Critical for Optimum Grass Yields**

Potassium and nitrogen were top-dressed at various rates to orchardgrass for the fourth year. Results obtained supported data from previous years. Topdressings of 200 pounds N and 83 pounds K per acre per year resulted in highest dry-matter yields (3.82 tons per acre) and best recovery of N, P, and K by the plant. The 2.4 to 1 ratio of N to K was the best ratio tested at all

nitrogen rates. A lower ratio, perhaps 1.8 to 1, on soils with lower K-supplying powers than the one used probably would be more desirable.

In general, the best treatment for economical orchardgrass production would be 83 pounds of K per acre, annually applied, and 150 pounds of N per acre split into two or three applications per year.

*(Project 0-59)*

### **Response of Forages and Certain Grain Crops To Fertilizers**

After 6 years of continuous fertilization of alfalfa, an estimate may be made as to the minimum amount of fertilizer which may be used to maintain consistently good yields. The amount is approximately 130 lbs. of 0-10-30 for each ton of alfalfa harvested. These results are in accord with the results of plant-tissue analysis for phosphorus and potash, but be-

cause of luxury feeding, are somewhat higher than the so-called critical levels developed at Rutgers, Cornell, Maryland and other stations. It should be noted that this is a maintenance application that must be applied every year and is not a recommendation for a seeding establishment of alfalfa.

*(Project 0-62)*

## Performance of Nitrogen Sources Fall or Spring-Applied

The properties of different nitrogen carriers cause differences in their performances when applied to soil under a variety of climatic conditions. Some carriers are subject to leaching, some to volatilization, etc.

To study this problem, nitrogen was topdressed on orchardgrass in split or single applications at rates of 0, 70, 140, and 280 pounds per acre. Sources were urea,  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and a mixture of 75% nitrogen as urea-formaldehyde and 25% as urea. Application was made on one or a combina-

tion of the following dates: September 15, October 30, December 15, March 15, and after the first cutting in the spring (May 15). Soil temperatures at depths of 2 and 6 inches were recorded periodically. Soil samples were taken periodically and will be tested for nitrate—and ammonium-nitrogen. Yield and quality of forage will be measured. The September application appeared to be too early for sufficient carryover into the following growing season.

*(Project 0-63)*

## Nutrient Balance in Midland Bermudagrass Studied

A nitrogen-potassium nutrient balance study on Midland Bermudagrass was continued. Response of bermudagrass to applied potassium did not become evident until the latter half of the growing season. Until then, the soil was able to supply K required in excess of that applied. Maximum economical yields (6.83 tons of dry mat-

ter per acre) were obtained with topdressings of 400 pounds of N and 83 pounds of K per acre. The N was split into four equal applications and the K into two. Greater response to K is expected in subsequent years of the experiment, since the K reserves of the soil have now been largely depleted.

*(Project 0-64)*

## Grass Needs Nitrogen When Legume Declines

When legumes such as red clover and Ladino clover make up a large percentage of the legume-grass association, enough atmospheric N is fixed for both species. However, if and when the legume begins to die out, a point should be reached when the remaining legume can no longer supply enough N for itself and the associated grass.

An experiment is in progress to determine this point and the rate of N necessary for optimum yield. Economical yield responses were gained in the

first year with 50 and 100 pounds of N per acre when Ladino clover content was less than 25% of the mixture. No conclusive results were obtained when orchardgrass was in association with red clover. Legume percentages in both associations were lowered considerably when 50 or 100 pounds of N per acre were applied to mixtures with legume percentages above 20%. Alfalfa-orchardgrass in different percentage combinations is being included in this year's study.

*(Project 0-65)*

## **Climate of the Northeast**

Agricultural climatology of the Northeastern States is the subject of a series of regional bulletins. Two are now published, one on low temperatures of spring and fall, the other on rainfall probabilities for one to three-week periods. Now in the mill are studies of: heating degree days, growing degree days, drought probabilities, and temperature distributions about harmonic curves.

The relationship between air pollution and "weather fleck" of tobacco and cultural and fertilization practices was studied. Frequency and severity of weather fleck was positively correlated with added water and low nitrogen supply, but was not related to plant population. On the other hand, leaf drop at harvest was intensified to the greatest extent by high populations. *Project (BOQR-84(NE-35)*

## **Supplemental Irrigation on Tobacco and Forage Crops**

A 7-year study of supplemental irrigation in combination with variation in fertilizer rates and management practices supports the following conclusions:

Tobacco response to irrigation was influenced by the overall level of cultural practices. Except in two very dry years, benefits from added water have been marginal. In the wettest seasons irrigation at low moisture stress was usually detrimental; whereas, if higher stress was allowed to develop,

gains in yield and acre value were found at the higher nitrogen rates and with denser plant populations.

The response to irrigation was greater for the several grasses than for alfalfa and Ladino clover. Although production was more uniform throughout the growing season, only small increases in total yield resulted from irrigation. The efficiency of nitrogen utilization by the grasses was generally increased by irrigation.

*(Project BQ-83(NE-22)*

## **Can Nitrogen-Fertilized Grasses Replace Grass-Clover Mixtures?**

With suburbia rapidly encroaching on the valuable farmland of the Northeast it becomes more and more important for farmers to utilize every acre in the most efficient manner. One way to increase pasture production is through the use of high rates of nitrogen fertilizer. To find the answers on how dairy cows respond to this type of pasture a cooperative study is being

conducted by the Departments of Dairy Science and Agronomy. Results to date confirm that greatest forage yield and animal-carrying capacity is obtained from grass heavily fertilized with nitrogen; but the best individual cow performance is from those animals grazing grass-clover mixtures.

*(Project BG-1)*

## **Summer Annual Grazing Study**

As livestock farmers evaluate their forage needs at the start of a new growing season the specter of drought is always present. For this reason sum-

mer annual grasses play an important part in the forage management plans of Maryland livestock farmers. A study is currently underway at the Agronomy-

Dairy Forage Research Farm in which Sudangrass, pearl millet, and a commercial sorghum-Sudangrass hybrid are being compared as pasture for dairy cows. These three pastures are essentially equal in dry-matter production,

carrying capacity and milk production. However, butterfat production is severely depressed in cows grazing pearl millet when no other forage is fed.

*(Project BG-2)*

### **Evaluation of New Soybean Varieties Emphasizes Seed Quality**

Soybean varietal improvement research indicates a need for improved seed quality among varieties of earlier maturing soybeans adapted to the Middle-Atlantic area. Eight new varie-

ties have been introduced to Maryland farmers during the past 10 years as a consequence of this program of continual evaluation of breeding materials.

*(Project B-43)*

### **Breeding for Better Dent Corn**

Breeders and geneticists have devoted much time to improving America's major cereal crop. This versatile crop has been modified in many ways—size, shape, maturity, composition, disease resistance, productivity. Almost every farming locality in the United States grows hybrids that have demonstrated superiority locally.

In spite of past accomplishments, corn is still susceptible to genetic modifications that will enhance its value to an ever-changing agriculture. In

Maryland, current effort is concerned with finding more stalk rot resistance, medium-height plants, and hybrids most suitable for silage production. Several inbreds; namely, J48, W153R and Oh43, have been demonstrating some value in breeding for better stalk quality. On a dry-matter basis hybrids OhW64 and NE912 were superior to two multiear hybrids, two dwarf hybrids and one forage type sorghum hybrid for use as silage in 1961.

*(Project B-50)*

### **World Collection of White Clovers; Test of Persistence**

A world collection of white clovers exhibited considerable variation for morphological characteristics but a general lack of persistence for the species.

A study of the effects of management and environmental factors upon persistency of Ladino clover indicates that an entomological-pathological

complex is involved in the lack of persistence in that variety. Plots treated with soil and foliar insecticides and fungicides exhibited perfect stands of Ladino 2½ years after establishment; check plots receiving no treatment suffered complete loss of stands.

*(Project B-56-g)*

### **Testing Regional Synthetic Varieties of Forage Plants**

Synthetics and generations of synthetics of alfalfa, orchardgrass, and brome grass are being evaluated currently under different cutting managements. Preliminary results (first harvest year) indicated no significant decreases in yields of forage in the Syn<sub>2</sub> generation, as compared to Syn<sub>1</sub>.

Flemish-type alfalfas were superior only under the severe (4-cut) cutting treatment. Several orchardgrass synthetics were superior in production of aftermath; one brome grass synthetic was superior, consistently, for the Northeast Region.

*(Project B-56-i)*

## New Pasture Systems Under Test

Experimental results of the past few years have demonstrated that improved pasture combinations can substantially increase beef production per acre. For example, Midland Bermudagrass in which rye has been sod-seeded in the fall has produced well over 700 lbs. of beef per acre while production from other recommended pastures has seldom been more than 400 lbs.

The use of bluegrass pasture in conjunction with Midland and sod-seeded rye not only result in high beef pro-

duction per acre but also made it possible to maintain a uniform number of animals on grazing alone throughout the spring, summer, and fall months. The rye—Midland—bluegrass pasture combination was found to be slightly superior to the rye-orchardgrass-sudangrass combination in terms of total beef production and animal carrying capacity, but slightly inferior with regard to individual animal performance.

*(Project B-56-j)*

## Wheat Breeding and Evaluation

Soft red winter wheat has long been an important crop in Maryland. Although the annual harvested acreage is only about half what it was 10 years ago, the 1961 figure of 142,000 acres still leaves it in third place, behind corn and soybeans, as a major field crop in the state. The persistence of its importance seems to justify effort to extend varietal improvement.

Straw strength, mildew resistance

and varietal response to fertilization have been given much consideration. Most of the experimental selections developed by breeders in the eastern and southern states pass through the co-operative uniform nurseries conducted by the Maryland Station. Some of the new selections are showing improvement in straw strength and mildew resistance.

*(Project B-66)*



Instrument developed by project leader at Maryland Tobacco Farm to measure height and plant type. Left, tall upright plants. Right, low prostrate plants.



## Varietal Improvement in Barley and Oats

In recent years the importance of feed grains—barley and oats—has increased in Maryland. Winter barley and both winter oats and spring oats are grown here. Compared to winter wheat, winter barley and both types of oats are more restricted by soil and climatic conditions. More good varieties in each of these crops are needed to take care of environmental differences. There is much room for improvement in disease resistance, tolerance to heat and cold, and straw strength at high fertility levels.

By participation in cooperative uniform nurseries with other states in the East, all promising new experimental lines are being studied as they appear. In 1961, five experimental barley lines were noteworthy in that they combined good resistance to smut and mildew with good straw strength. New winter oat selections showed improvement in cold tolerance.

*(Project B-67)*

## Rotational Practices Influence Growth and Quality of Tobacco

Eight 2-year rotational systems were established a year ago and grew their first tobacco crops in 1961. The alternate crops included: wheat, wheat and lespedeza, barley and soybeans for hay, barley and soybeans and sorghum for silage, winter vetch allowed to fall, winter vetch followed by corn, rye and millet each for green feed, and redtop and alsike clover.

One year's data on the tobacco crop may be summarized briefly. Vetch allowed to fall, also barley and soybeans for hay significantly lowered price per



Upper photo—soybeans treated with pre-emergence herbicide, amiber. Bottom photo—untreated soybeans, not many weeds, but enough to lower yields by several bushels.

pound, but the vetch tied with redtop and alsike clover for top yield, closely followed by barley and soybeans. No other yields were significantly better than the lowest ones—wheat allowed to fall, or vetch and corn. The highest prices were obtained from vetch and corn, wheat allowed to fall, and rye, millet and sorghum as green feeds. The yield-price correlation was mostly an inverse one, which probably contributed to nonsignificance of acre values.

*(Project B-68)*

## Growth of Foxtail and Chemical Control Measures

One of the important questions regarding annual weeds concerns the date at which a seed head can be removed and thus prevent the plant from producing viable seed. Heads of giant and yellow foxtail were harvested in the boot, flowering, milk, and dough stages. All these heads with the exception of those harvested at the boot stage produced viable seed.

These two foxtail species (*Setaria* spp.) were also tested with atrazine at four different stages. Resistance to atra-

zine developed rapidly and at the four-leaf stage only 60% kill was obtained. At the later stages there was little or no kill. The foxtails reacted similarly to applications of dalapon. Plant injury appeared to be inversely proportional to maturity.

An investigation of the temperatures necessary for germination revealed that some germination occurred at 58°F, but the optimum temperature was 70°F.

*(Project B-70 (NE-42))*

## Testing for Varietal Purity in Alfalfa

Testing procedures are established for such seed characteristics as germination, purity and freedom from weed seeds. Tests for varietal purity take from several months to a year to complete. Rapid tests for varietal purity are needed for those crops not easily distinguished by seed characteristics.



Soybean herbicide trials (foreground) is untreated check; background, treated with preemergence herbicide.

Maryland in general is a seed-consuming state. Much seed planted here is produced at distant locations. At present, the only method available to check on authenticity of seed is through the certified-seed program. In this project rapid methods for measuring varietal purity of alfalfa seeds are being investigated. A series of tests is needed to complete positive identification in many cases. Varieties are being catalogued as to their response to those characteristics. Four authentic samples and twelve unknown samples were planted in 1961. Flowering dates and color were recorded. Recovery, plant type, and stem size notes were taken.

*(Project B-72)*

## Tested Varieties Recommended for Seeding

Tests continued over several years have indicated many new crop varieties suitable for planting in Maryland.

An outstanding new soybean variety developed specifically for Maryland and Delaware is the Delmar. It is a high-yield soybean of outstanding seed quality and resistant to nematode. Other recently suggested crop varieties include





Weed control in tobacco—weed-free area was treated at transplanting time with EPTC. These plants have not been cultivated.

Andrews spring oats, somewhat resistant to leaf rust and blight, and hybrid corns of proved adaptability to length of growing season. Norline, Dubois and Bronco winter oats are adapted to certain sections of Maryland. Cayuga, Cherokee, and Sernac appear to be promising alfalfa varieties. Tufcote and

U-3 Bermudagrass show possibilities for lawns, fairways, and airports.

Department recommendations are based on actual tests over the years and on seed supplies available. Further, it is stated:

“Certified seed is your best guarantee of varietal purity.”

*(Projects B-72 and B-43)*

### **Pure Grass Stands Require Careful Management**

First harvest yields of Potomac orchard, Pennlate orchard, Saratoga brome, and reed canary were increased as the first harvest was delayed 2 weeks past early bloom. Quality was drastically reduced for all grasses when harvests were delayed beyond the boot stage. This was particularly true with the orchardgrasses. When the first harvest of Saratoga was made prior to the early joint stage stands were drastically reduced. This was particularly true if

the growing point was removed with the first aftermath harvest. When the growing point of Saratoga and reed canary was not removed at the first aftermath harvest total production was higher and production was shifted more to the mid-summer when pasture is usually shortest. Since orchardgrass makes a different type of aftermath growth, this shift in production was not obtained.

*(Project B-73)*

### **Efficient Production of Quality Midland Bermudagrass**

Superior summer production of a perennial forage crop is possible with Midland Bermudagrass yields of over

8 tons of dry matter per acre. It is difficult to produce good quality yields of this magnitude; however, by imposing

the proper harvesting schedule and fertilizer application high quality forage with yields of over 6 tons per acre are easily obtained. This experiment has demonstrated that forage quality can be greatly improved by high nitro-

gen fertilization along with adequate phosphorus, potassium and lime and by frequent harvesting. Frequent, close harvesting does not adversely affect the stands of Midland Bermudagrass.

*(Project B-74)*

### **Greater Efficiency of New Sod-Seeding Forage Techniques**

Forage production from an acre of Midland Bermuda can be greatly increased by proper selection and management of annual forages, such as cereal, rye or hairy vetch seeded directly into the existing Midland sod without plowing or other means of seedbed preparation. This increased production in the fall and early spring can be obtained without reducing the summer yields of the Midland. Greatest fall production can be obtained with close row spacing, high seeding

rate, and high nitrogen fertilization. Adequate nitrogen appears to be the most important factor in the spring forage production of rye.

Pasture quality and yield of clover-deficient bluegrass pastures can now be improved by new effective methods of reestablishing legumes in grass dominant pastures. Two experimental openers which are superior to the conventional "Grassland Drill" opener have been developed.

*(Project B-75)*

### **Breeding and Genetic Studies In Red Clover Progress**

A method of circumventing the high degree of self-sterility in red clover is being investigated currently. Genetic studies indicate interactions among alleles conditioning self-incompatibility

in this species. More persistent and mildew-resistant red clovers are prominent among breeding materials being evaluated.

*(Project B-76)*

### **Superior Alfalfa, Clover, and Bermudagrass Varieties Recommended**

Continual evaluation of varieties of the major species of forages insures Maryland farmers the best adapted and most productive of forage crop varieties. Chesapeake red clover, Midland Bermudagrass, and Pilgrim white clover have exhibited superior perform-

ance for a number of years. Several superior varieties of alfalfa are discernible; the most important characteristic is that of adaptation to the area involved. Du Puit, Williamsburg, Vernal, and Narragansett are alfalfa varieties of great merit.

*(Project B-77)*

### **Control of Weeds In Crops, Turf and Brush**

Field trials were continued with corn. In preemergence trials a new compound, linuron, was found to be a very good herbicide causing no injury to corn. A combination of atrazine and nitrogen showed no improvement over

atrazine alone. The use of herbicides after corn is up showed that linuron was effective on fairly mature weeds. In this respect it is better than atrazine. Where corn was cultivated after band application of herbicides, it was found

that in general, cultivation did not lessen the effectiveness of the herbicide.

Preemergence trials in soybeans showed the effectiveness of amiben. Linuron was also found to be effective in controlling weeds through the season. A small proportion of the herbicides tested was injurious to the soybeans. It was found in general that granular forms were equal to liquids in effectiveness.

Nutgrass is a prevalent weed in many cornfields and a field test was designed to test various materials for its control. It appears that atrazine at 4 pounds per acre as an early postemergence will provide good control.

The effort to find acceptable herbicides for tobacco fields was continued. EPTC and amiben are showing con-

siderable promise. Tobacco harvested from these plots was of excellent quality and the yields were above the check. In a screening test for herbicides it was found that Dacthal and casoron injured the tobacco.

Crabgrass control plots were again established and in general products now on the market resulted in good control. Several experimental materials were tested. A Stauffer chemical, R-4461, gave excellent control. Once again chlordane did not perform as well as Dacthal or Zytron. An experiment was conducted to determine the effect of several turf herbicides on germinating and seedling grasses. With few exceptions they were toxic to the desirable species.

*(Project B-78)*

## **Use of Herbicides to Control Weeds in Forages**

The rapid increase in wild turnip infestation of alfalfa is now subject to control. Research indicates that 2,4-DB spread at a rate of 1 pound per acre, controls wild turnip. Treatments should be made only when alfalfa is growing well. Yellow rocket, henbit, shepherds-purse need higher rates for control. This chemical appears also to control Canada thistle in alfalfa.

The control of Knapweed or German moss in alfalfa appears to be accomplished with 4 pounds per acre of CIPC or dinitro at 4 pounds per acre.

Preemergence or preplanting treatments for weed control continue to appear promising. EPTC, as well as some other herbicides, gave good weed control.

*(Project B-79)*

## **Investigations of the Effect of Herbicides on Plants**

A recently discovered and released herbicide is under investigation relative to its absorption, translocation, and mode of action in plants. The herbicide, 3-(3,4-dichlorophenyl)-1-methoxy-1-methyl urea, applied to the soil at planting time allowed snap beans to germinate, but high rates caused severe necrosis and death of the plants. When the material was ap-

plied at emergence or at the first trifoliolate, there was considerably more injury. Even the very low concentrations caused eventual death. A single drop applied to a leaf, however, did not harm the plant. The leaf formed an abscission layer and dropped, thus indicating that the chemical is not translocated downwards.

*(Project B-80)*

## Summer Annual Management Study

Summer annual grasses are rapid growers and high producers. It is important, therefore, to manage these crops for high yields and high quality over a short period of time. Sudan-grass, pearl millet, and a sorghum-Sudangrass hybrid are being compared under pasture and green-chop manage-

ment with three stubble heights and two nitrogen fertilizer levels. Green-chop management with a 4-inch stubble height appears to be more productive than the other treatments. High nitrogen fertilization has given no measurable response on these grasses. *(Project B-82)*

## Soil Temperature and its Effect on Forage Crops

Combinations of soil and climatic conditions react with a specific crop species or variety to make it a desirable or undesirable species for a particular area. In order to gain more basic information on the effects of soil temperature on plant growth, field temperature studies are being initiated. Plants

can be grown in growth chambers where various factors are strictly controlled. However, it is difficult to entirely duplicate the varied conditions found in the field. This study is designed to help explain the relationships between field and growth-chamber data. *(Project B-83)*

## Late Planting and Winter Survival in Oats

More cold resistance, especially during early growth, would make winter oats more useful in Maryland. At present, all known recommended varieties are less tolerant to cold than winter varieties of barley, wheat and rye. When planted at the optimum time, winter oats occasionally suffer serious stand damage even in eastern and southern Maryland, where winters are comparatively mild.

In cooperation with other northeastern states, an attempt is being made to find varieties with greater ultimate hardiness, and with more rapid development of hardiness in the seedling stage in order to permit later planting in the fall. To this end, seven of the more hardy varieties available—Cimar-

ron, Early Wintok, Wintok, LeConte, Dubois, Ballard, and Nysel—are being compared when planted in the nursery, on three planting dates—October 1, 10 and 20. At the same time additional plantings are made in greenhouse flats placed near the nursery.

In order to check the development of cold tolerance as winter approaches, flats are brought to the laboratory from time to time and placed in freezers to determine the cold exposure necessary to produce differential kill. To date, cold tolerance appears to develop very rapidly in all seedlings as fall temperatures drop below the growth level. Also, there appears to be an association between early seedling hardiness and ultimate hardiness. *(Project B-85 (NE-23))*

## **Corn Silage Tops in TDN**

Corn silage is potentially the highest producer of TDN per acre. Farmers attempt to realize this potential, and in doing so frequently apply high rates of nitrogen fertilizer to the corn silage crop. Corn silage grown under 0 and 200 pounds of nitrogen was ensiled and fed to milking cows in a study conducted by the Departments of Agronomy and Dairy. The higher rate of nitrogen fertilizer produced a half ton more silage than the no-nitrogen treatment.

During the ensiling period nitrogen dioxide, a poisonous gas, was observed flowing out of the silo containing the high-nitrogen silage. Subsequently analysis of the silage for nitrate, however, revealed levels of nitrate considerably lower than those considered to be toxic. The silages from both treatments were of equal value when fed to milking cows.

*(Project B-86)*

## **Maryland Tobacco Yields With Nitrogen**

Tobacco has long been considered a crop with an incompatibility between high yields and high quality. Work at the Maryland Station continues to show that yields can be raised within limits without causing an offsetting loss in quality.

In 1961 several varieties were grown in a fertility test in which the nitrogen rates of 60, 90, 120, and 180 pounds per acre were used. The peak acre yield (1920 lbs.) for the variety, Caterton, was obtained at 120 lbs. of nitro-

gen, as compared to 1523 lbs. at the 60 lb. N rate. Market values per pound of crop ranged from 67.2 cents for the 60 lb. N rate to 70.6 cents for the 90 lb. N rate. Apparently, in this particular season high rates of nitrogen fertilizer improved market quality and increased yields. More observations, however, will be needed to determine maximum acceptable levels of production in relation to ease of curing and final dollar value.

*(Project B-87)*

## **Physio-Chemical Changes in Tobacco**

The Maryland version of tobacco curing under pressure with moving air, named "compact" curing, apparently produced tobacco of normal chemical composition. Total nitrogen and protein nitrogen contents were identical with air-cured barn samples.

Differences were found in varietal

susceptibility to cellulose-destroying pathogens associated with "houseburn" in curing. Wilson suffered tenfold losses in barn curing and threefold losses in control chambers, as compared with other Maryland varieties. A chemical explanation is being sought.

*(Project B-89)*

## **Nitrogen Supply and Forage Production Efficiency of Midland**

Greater efficiency in forage production of Midland Bermudagrass can be obtained by using ammonium nitrate rather than urea as a source of nitrogen fertilization. This is particularly true at nitrogen rates above 100 lbs. Forage production was more uniformly distributed with four rather than two applica-

tions of nitrogen. In 1960 total forage yields were also increased with four rather than two nitrogen applications. This was not true in 1961, due primarily to poor rainfall distribution. The more frequent nitrogen applications also resulted in fewer weeds.

*(Project B-93)*

# ANIMAL SCIENCE

The change of name in the department from Animal Husbandry to Animal Science has not been accompanied by any significant change in the research program, inasmuch as the program has included and still includes both so-called fundamental and applied types of research.

During the past year new projects have been initiated, additional facilities acquired, and some shifts in emphasis made within the program.

## **New Swine Facilities at Research Farm**

Facilities for swine research are now in operation at the Agronomy-Dairy Forage Research Farm in Howard County.

The permanent buildings were designed to permit maximum practical flexibility of usefulness. The interiors of the farrowing and feeding barns can be rearranged to provide optimum pen design and sizes for various experimental problems. Problems related to confinement rearing and multiple farrowing can be investigated. In addition, rotated pasture will be available

for routine management of the breeding herd and comparisons to confinement managements.

Four times each year twenty litters can be farrowed and managed under optimum conditions with these facilities. The overall program will include research in areas of nutrition, reproductive performance and herd improvement. A manure disposal lagoon has also been provided to obtain information on manure handling.

*(Project C-28)*

## **Fish Meal Compared as Protein Supplement for Swine**

Fish meal has long been recognized as an excellent protein supplement for swine. However, in recent years economic conditions and the commercial production of vitamin preparations have resulted in the increased use of soybean oil meal as the sole protein supplement in rations for growing-finishing swine. Studies are being conducted to reevaluate the inclusion of fish meal in rations for swine, with special attention to the method of fish meal processing and the chemical composition of the fish meal fed to swine.

Rations for growing-finishing swine that contained different levels of pro-

tein and different levels of fish meal have been fed in summer and winter trials. The performance of pigs fed these rations was compared to that of pigs fed rations with only soybean oil meal as the protein supplement. Either 2% or 4% fish meal was included in the test rations along with a sufficient amount of soybean oil meal to provide initial rations containing 16%, 15%, and 14% crude protein. The pigs were started on these rations at an average weight of approximately 50 pounds and the total crude protein level for all rations was reduced by 2% when the pigs averaged 125 pounds and an ad-

ditional 2% when they averaged 150 pounds. All rations were evaluated on the basis of daily rate of gain, feed efficiency and carcass measurements, taken at the time of slaughter of the test animals at weights of 195 to 205 pounds.

At the protein levels studied in these trials, replacement of protein supplied by soybean oil meal with that available from fish meal did not improve the rations. Growth rates and feed efficiencies were very similar for pigs fed the different rations. Considerable var-

iation was noted in carcass characteristics within each treatment and no treatment differences were observed that were related to the kind of ration that was fed. Taste tests of pork from pigs in each of the treatment groups did not reveal any residual fish flavor as a result of feeding the fish meal. The fact that the performance of pigs on the lower level of crude protein was equal to the others studied indicates the need for continued investigation of the protein requirements of swine.

*(Project C-33)*

### **Protein Utilization By Swine On Restricted-Energy Consumption**

Protein requirements for self-fed swine are usually expressed as an absolute amount per day or as a percent of the total diet. Increased interest in the benefits of energy restriction for finishing swine, i.e., greater feed efficiency and leaner carcasses, suggested the desirability for evaluating the protein utilization of pigs fed a limited ration of supplemented corn and soybean oil meal.

Two levels of protein were studied. The recommended allowance of crude protein was fed in an energy-restricting ration that was formulated to supply all the known nutrient requirements for swine. A ration that was the same in

all respects other than protein supplied 25% more crude protein to similar groups of pigs fed in the same manner.

The imposed energy restriction did not result in more effective utilization of the higher level of crude protein. Rates of gain and feed efficiencies were nearly equal for the two treatments. The controlled energy consumption was associated with uniform gains in all lots of pigs on the test. Carcass measurements taken when all pigs were slaughtered at an average weight of 190 pounds did not indicate any increased muscle development resulting from a greater intake of protein.

*(Project C-35)*

### **Study of Urea and Roughage Diets**

One of the major objectives of studies in ruminant nutrition has been to find economic sources of protein. In all livestock-feeding economies, protein is in relatively short supply and high-protein feeds usually cost considerably more than low-protein feeds of similar energy value. In many cases the high cost of protein hinders the utilization of feedstuffs otherwise suitable for ruminants. Ruminants are able to utilize

nonprotein nitrogen (NPN), such as that found in urea, due to protein synthesis by the microbial population of the rumen, if a satisfactorily balanced nutrient intake for economic performance of the animal can be achieved. High-energy, low-protein feeds such as corn or other grains are rather easily supplemented with NPN because the readily available energy of the concentrates promotes rapid proliferation of



the rumen population. Low-energy, low-protein roughages are more difficult to supplement and the lack of available energy usually results in poor utilization of urea and other NPN sources. Experiments designed to study various factors which may be related to the utilization of NPN by ruminants on roughage diets have been initiated.

Ruminal ammonia, released from urea hydrolyzed by rumen microorganisms, is rapidly lost if not incorporated into amino acids and protein, and this nitrogen loss is apparently a major reason for poor NPN utilization by ruminants on low-energy diets which do not support rapid protein synthesis. It is possible that frequent intake of a NPN supplement, as opposed to twice-a-day feeding, would increase nitrogen

utilization with low-energy diets by resulting in an ammonia release more nearly concomitant with energy availability. Cattle allowed *ad lib* consumption of Sudangrass silage were fed a concentrate mixture made up of corn, molasses and urea either two or eight times daily. Frequent feeding did not result in more rapid weight gain or improved feed efficiency and there was no evidence in this study that the treatments affected nitrogen utilization. Concentrations and molar percentages of rumen volatile fatty acids (VFA) were also unaffected by frequency of feeding. However, intake of the Sudangrass silage was not sufficient to provide energy for rapid gain, and it is possible that the protein need of the animals was not challenged, and thus no information



The ewe lambs on the right received 10 percent of urea in a molasses-water supplement, self-fed with pelleted corn cobs; gained 17 pounds in 42 days. The lambs on the left received no urea; lost 13 pounds in the 6-weeks period.



relative to urea utilization could be expected. Studies with lambs are now in progress to further test the effects of frequency of feeding upon urea utilization in animals on high roughage diets. Pelleted diets which offer low protein roughages in a more palatable form are being used and it is hoped that forage intake will be sufficient to allow some measurement of NPN utilization.

The formulation of liquid molasses-urea supplements which can be self-fed with high roughage diets is also being investigated. In two trials completed to date, mixtures containing cane molasses, water and 10 percent urea by weight have been satisfactory for supplementing pelleted orchard grass hay or pelleted corn cobs. These roughages did not support body weight in lambs fed

no protein supplement. Forage consumption was almost doubled by supplementation. Urea in liquid supplements at 10 percent apparently controls supplement intake at a level desirable for the protein need and the balance achieved promotes forage intake. Liquid mixtures containing 3 or 5 percent urea were not satisfactory as they resulted in excess molasses consumption and a depressed intake of the roughages with concomitant depression in rates of gain and feed efficiency. Supplements containing as much as 20 percent urea have been satisfactorily fed to lambs accustomed to urea supplements and pelleted corn cobs. More information is needed relative to the safety of high-urea mixes under a variety of conditions. *(Project C-36)*

## **Performance Records of Beef Animals**

The second project dealing with the performance of beef cattle is a revision, extension, and in part, a continuation of work started in 1948. The work is divided into two phases. The first is an analysis of the records of the herd of a cooperating producer. Pedigree, birth and similar records usually kept on purebred herds are available from the start of the herd in 1939. Starting in 1954, weaning weights and feed-lot gains have been available, and more recently, birth weights have been obtained. Approximately 2000 calves are involved. Five generation pedigrees have been compiled for all breeding animals and offspring. All records have been organized and are now ready for processing. A complete study of the data is planned, including genetic and environmental variables.

The second phase of the project is that of the use of presently developed objective methods for selecting breeding animals and the development of new, objective methods that would be of practical use. This phase is being done in cooperation with the same co-operating producer (Wye Plantation, Queenstown, Maryland) as is the first phase. Two new barns have been erected wherein 42 calves can be fed individually. Birth, 28-day, weaning, yearling, and other weights will be obtained, as well as rates of gain, feed efficiency, carcass records, and bodily measurements, all of which will serve as basic records. Work on the development of new criteria for selection will be started soon.

*(Project C-39)*

## **Bodily Measurements And Weights Of Wholesale Cuts**

At present, 230 different measurements are being taken on live slaughter steers as well as the weights of 16 wholesale cuts of the carcasses of the steers. Combinations of some of the measurements now permits the use of 300 or more variables for use in estimating the weight of each cut. One hundred steers in the weight range of 1000 to 1050 pounds have been measured and the variables correlated (ap-

proximately 50,000 correlations). These are being studied preparatory to the calculation of prediction equations. Seventy-five steers of the weight range of 900 to 950 pounds have been measured and carcass data obtained. These data will be analyzed as soon as a total of 100 steers have been measured. Results will be published as soon as possible.

*(Project C-40)*

## **Performance Testing Of Beef Cattle To Study Criteria Used In Selection Indices**

Two similar but significantly different projects relative to testing the performance of herds and the development and/or use of new criteria for selection and the comparison of older and newer methods are now in progress.

A study has been initiated to evaluate factors used in selection indices for beef cattle improvement and to evaluate the present University of Maryland beef cattle herds through progeny-performance testing. Selection indices have been widely used in the development of livestock; however, indices used in beef cattle improvement today include only a few traits, usually weaning weights and score. Because there is little or no information concerning a number of other factors of economic importance necessary to evaluate beef cattle properly, a study of this nature has been undertaken.

The University of Maryland's Purebred Angus and Hereford cattle herds will be used for this study. For a number of years various records, such as calving records, birth and monthly weights on all cattle, gains in feed lots, conformation scores, and some carcass data, have been collected on the herds. These records will form the foundation

for the initial index. Data similar to that mentioned above plus more complete carcass information will be obtained.

After weaning, all calves will be allotted by sire, sex, weight and grade into as uniform groups as possible and fed for gain-test trials.

The ration used will be coarsely cracked yellow corn, soybean oil meal, and U. S. No. 2 alfalfa hay.

In order to establish a standard for the herds as to size, other than weight only, a series of linear measurements are being taken. It should be possible to find out if a more descriptive picture can be given to size than has been done in the past. In addition, the cow herds will be scored on desired as well as defective characteristics for future study. Linear measurements will also be taken on all slaughter cattle in order to continue study of the relationships of linear measurements to carcass merit.

The ultimate purpose of raising beef cattle is to supply the needs and desires of consumers for meat. Thus, the exclusion of carcass merit from any beef cattle index does not permit the consideration of our most important product, meat. Therefore, detail carcass data

will be collected on all steers and on all nonreplacement heifers. Basically, the objective is the efficient production of a high-quality, meaty carcass.

The breeder of beef cattle needs practical yardsticks to measure individuals and their transmitting ability. The difficulty in beef cattle evaluation is that final judgment on the quality of carcass, proportion and distribution of fat and lean cannot be evaluated until

after the animal has been slaughtered. Progeny-performance test based upon actual performance is probably the best way to allow the application of present-day knowledge to beef cattle improvement and to search for newer and better yardsticks. Index values calculated on the basis of a herd should be of practical value in guiding producers in the construction of practical indices for their own herd. (Project C-41)

## Practical Disease Control Studies

Disease problems, especially with baby pigs and growing pigs, are of major significance in profitable swine production. The control of disease levels is considered paramount in sound management of the swine enterprise.

In order to provide a herd of swine with a minimal disease level at the department's new swine facilities, a method of rearing baby pigs in isolation from infected sows has been studied. The method is somewhat simpler than the procedure employed with surgically derived Specific Pathogen Free (S P F) pigs. The method would also allow populating the new facilities from lines of known quality.

Transmission of the troublesome diseases of virus pig pneumonia and atrophic rhinitis is theoretically not possible unless there is direct mouth or nasal contact between infected carriers and uninfected baby pigs. Therefore, if pigs are isolated immediately at the time of birth they should not be infected. It has also been suggested that certain forms of enteritis may be eliminated in this manner.

Sows were washed and disinfected thoroughly and then moved to a similarly cleaned pen 2 to 3 days before the due date for farrowing and then kept under continuous observation. Immediately at the time of birth, pigs were

removed from the sow before they came in contact with the floor or any objects in the immediate environment.

A nursery was set up in a heated room. The pigs were individually penned in cages constructed with pine lumber and 1/4 inch wire mesh. Thirty two individual cages were available in the 10 x 12-foot room. Supplementary gas heaters were also provided to give an initial room temperature of 90 to 95 degrees F. Air movement (drafts) was eliminated as much as possible. The room temperature was gradually reduced to 65 to 70 degrees after the first week.

The pigs were fed four times daily in hard rubber feeding bowls. A synthetic milk replacer based on dried milk with supplementation was mixed with warm water at each feeding. The amount per feeding was gradually increased from 1 ounce initially to 12-15 ounces at 3 weeks of age. When the pigs reached a weight of 6 to 8 pounds they were fed a pig-starter diet in meal form and clean water.

Pigs were started from 38 different litters. Survival rate in different litters ranged from 10% to 100%. Survival rates appeared to be influenced by management conditions and vigor of the pigs at birth. Initial growth of surviving pigs was rather slow, but after the

change to a meal diet it was quite satisfactory, with most of the pigs reaching 200 pounds between 5 and 6 months of age.

Autopsy of approximately 10 per cent of the pigs reared in isolation has not revealed evidence of atrophic rhinitis or virus pig pneumonia.

It has been found that several things will contribute to high survival rates for isolated pigs reared without initial sow colostrum. (1) Cages and all equipment must be completely cleaned between groups of pigs. (2) The nursery should be vacant for 2 to 3 weeks between groups of pigs. (3) Feeding bowls should be washed with warm water and soap after each feeding. (4) Drafts should be eliminated and initial temperature must be between 90 and 95 degrees. (5) Proper feeding and management of sows is essential to pro-

vide vigorous pigs at birth. (6) Subcutaneous injection of 5 cc of hog cholera serum with a high level of gamma globulin or feeding cow colostrum during the first 24 hours will give temporary protection from enteric infections. (7) Broad spectrum antibiotics and kaolin are helpful in controlling scours and enteric infections. (8) Individual cages for each pig during the first 10 days provides the necessary control of milk intake and eliminates ear and tail sucking.

The pigs were moved to the new facilities after they were growing well on the meal diet. Further study will be concerned with the incidence of common swine diseases in succeeding generations and the growth rate and feed efficiency under minimal disease conditions.

(Projects C-34, C-38)

## Mechanism of Bloat Studies

As reported last year, bloat could be produced in ruminants by injections of epinephrine (adrenaline) and atropine and orally administered L. Tyrosine replaced epinephrine in the experimental production of bloat.

The results with tyrosine suggest that components of the proteins of legumes could contribute to bloat. An animal bloats because eructation (belching) of the gases produced in the rumen is inhibited and it is possible that components of green legumes have action on the same physiological mechanism(s) as do epinephrine and atropine. Experiments have been performed to investigate the possible linkage between bloat produced experimentally with drug injections and that occurring naturally in ruminants grazing legume pastures.

Tyramine is known to have an adrenalinelike effect and can be produced by a simple decarboxylation of tyrosine.

To test the activity of tyramine, it was fed to sheep along with injected atropine. Bloat was produced with tyramine and atropine at levels of atropine which previous experimentation had indicated would not be effective when atropine was injected alone. The possible conversion of tyrosine to tyramine in rumen fluid was studied *in vitro* with radioactive tyrosine. Tyrosine was incubated with rumen fluid at several pH levels and the incubate was analyzed for tyramine. No free amine could be recovered from the incubate and the radioactivity was concentrated in what chemical tests indicated was a lipid complex. Activity in the complex increased as pH decreased from 6.8 to 4.2. These results suggest that the derivatives of tyrosine can form complexes with lipids in the rumen and thus the feeding of oils could inhibit the bloat-producing activity of orally administered tyrosine. To test this hypothesis

sheep which were known to bloat with orally administered tyrosine and injected atropine were fed cottonseed oil and tyrosine and injected with atropine. The addition of oil resulted in a sharply diminished bloat response. The formation of an amine oil complex which inactivated the amine and/or stopped its absorption could explain the inhibitory effect of the oil.

In further studies, various legume extracts have been tested by oral administration to sheep. The quantities given usually represented 5 to 10 pounds of green legumes.

Alkaloid extracts of alfalfa or Ladino clover showed some activity and produced bloat when fed with tyrosine or when fed in conjunction with injected epinephrine. Similar extracts of alfalfa did not result in bloat when fed without tyrosine or epinephrine. Thus it appears that alkaloids extracts of legume give an effect similar to atropine in the experimental production of bloat. A fraction representing the methanol extract of 20 pounds of green alfalfa administered to a sheep resulted in severe bloat and death of the animal.

Methanol extracts of smaller quantities of Ladino clover and white clover resulted in slight to moderate bloat. The further fractionation of methanol extracts of clovers with organic solvents resulted in preparations which showed adrenalinelike activity when tested on the frog. These results suggest that compounds or precursors of compounds with the pharmacological activity necessary for bloat are present in bloat-producing legumes in sufficient concentrations to account for natural bloat.

Recent reports in the literature suggest that the presence of ionic calcium or magnesium in the rumen will intensify bloating in sheep on legume pastures. The effects of calcium and magnesium have been studied by drenching sheep with solutions of  $Mg\ CO_3$ ,  $Ca\ CO_3$ ,  $Na\ HCO_3$  or  $Mg\ Cl_2$  and injecting with epinephrine and atropine. Control animals were drenched with water. The calcium or magnesium did not effect the bloat response to the injected drugs. Fifty-six slight to moderate cases of bloat resulted from sixty injections of epinephrine and atropine.

*(Project GC-45)*

# BOTANY

The mission of the Botany Department is to provide for studies on the fundamental nature of plants—their classification, structure, genetics, physiology and biochemistry. The research activities of the department include many topics of interest to practical agriculture, and its scientific publications add to the store of basic information that is improving our understanding of the living organisms. Investigations center on higher plant species as well as the micro-organisms which may aid in their growth or threaten their survival.

## Woody Plant Species Collected

Several trips were made to collect herbarium specimens and study the vegetation in less visited areas of Maryland. About two dozen species were found that had not been collected previously. Several hundred specimens, mostly woody plants, were accurately

identified. These herbarium specimens are of great value in the identification of the numerous specimens received throughout the year from residents of all parts of Maryland and also from county agents and other specialists.

*(Project F-12)*

## Scarcity of Twins Hampers Tree Investigation

In a tree-breeding program the time interval between generations is such that any shortcut deserves investigation. Most species of trees investigated so far have a low percentage of twin seedlings and among the twins, it was hoped, might be found haploids. These by subsequent doubling of the chromosome number would yield true breeding trees. Maple sugar is a relatively small but locally important crop in western Maryland and these seeds from high-yielding Vermont strains were obtained for study.

However, the pathway along which a given research must travel frequently

has annoying obstacles. Commercially maple fruits or keys are sown in the seed bed. In this investigation this could not be done because in each half of a key there are two ovules or potential seeds present. Hence the seed must be removed from the keys in order to eliminate the possibility that both ovules develop.

Approximately 18,000 half "keys" were opened and 7,650 seeds removed and in 11 instances both ovules had indeed developed. These seeds were placed in a germinator and less than half germinated; only one true twin was found.

*(Project F-17)*

## **X-Ray of Pollen Affects Heredity**

During the formation of the sex cells, each chromosome from the male parent becomes associated with a corresponding chromosome from the female parent. Pairing of like chromosomes permits exchanges of genes between chromosomes and thus allows the plant breeder to obtain new combinations of hereditary factors. Association in pairs is also necessary for fertility; the occurrence of unpaired chromosomes results in irregular numbers of chromosomes in the sex cells.

Studies were completed on two plants of pepper showing failure of association of like chromosomes. Both

plants occurred in the first generation following X-irradiation of the pollen. Although chromosomal behaviour was highly irregular in meiosis prior to the formation of the pollen, mitosis in the root-tips was not affected. The X-ray induced hereditary changes specifically affected the association of like chromosomes during meiosis. A number of crosses were made in corn and regal lily, utilizing X-rayed pollen to provide material for studies on the genetic control of the orderly association of like chromosomes in these species.

*(Project F-18)*

## **Search Continues For Chemical Controls of Root-Rot Organisms**

Certain types of diseases have caused considerable damage to many crops over many years. Among these are the root-rots caused by fungi, bacteria, and nematodes. Of these the fungi and nematodes are the worst offenders. Control is difficult and sometimes costly, or there are no controls. Resistance development and chemical controls in some instances have failed in controlling certain of these root rots. Sclerotinia root and crown rot of clovers and alfalfa has for many years caused whole fields to be decimated in a single season. At best the resistant varieties have only a high tolerance for this disease. Chemical controls are costly and not permanent. New nematocides are being tested every year. In early years a preplant fumigant was found followed by chemicals that could be mixed with fertilizer or sidedressed. A new

chemical is now being tested as a root dip to kill the nematode in the root. Multiple-control chemicals are being tested and used to kill fungi, nematodes and weeds.

In search for control there is always the problem of diagnosing and hunting for causes of new diseases. Fading-out disease of turf is a common malady, yet the causal organism is not known for certain. A new species of *Helicobasidium* has been found killing mosses, algae, liverworts, ferns, pine seedlings, tobacco and tomato seedlings, grasses, etc. How important is this fungus that can attack and kill such a wide variety of plant life? If it is important what control is needed? A considerable amount of research is needed on the nature, cause and control of root-rot troubles.

*(Project J-93)*



## Mor 59 and 609A Tobaccos Resistant to Black Shank Win Acceptance

The two varieties Mor 59 and 609A tested extensively in field trials on infested soil retain a very high degree of resistance. In 1961 neither variety lost a plant from 90 acres of infested soil. The high quality of the two lines was shown when they returned the highest average price in variety trials at the Tobacco Experimental Farm. From a quality standpoint both varieties have, over the past 4 years, been able to compete with other Maryland varieties. Total returns are lower per acre, due to less weight per acre (100-150 lbs. per acre less than most other Maryland varieties). Crosses with Mor 59 have

been made on Catterton, a better Maryland variety, to improve weight of the black shank-resistant variety.

Chemical tests on the Mor 59 and 609A by a leading tobacco company indicated that both varieties can be accepted as cigarette types from heavy or light soils. The percent ash and alkalinity of soluble ash were quite high, indicating good burn quality. Both Mor 59 and 609A had normal ratio of secondary amine (non-nicotine type) alkaloids to total alkaloids. Levels of nicotine were higher than in Catterton or Wilson, two excellent Maryland varieties. (Project J-95)

## Breeding For Multiple Disease Resistance In Tobacco

The tobacco variety development program consisted of three separate tests in 1961. The first was a nursery for plant selection for desirable physical characteristics, resistance to diseases and curing ability. Forty-six lines of Maryland tobacco combining resistance to wildfire, mosaic and black root-rot, 3 lines with multiple resistance to black shank, wildfire, mosaic and black root-rot, and 3 standards consisting of Catterton, Wilson and Moore were studied. Bed and field inoculations for wildfire and common mosaic were employed, and susceptible lines removed.

The second test was an evaluation of yield and quality of the most promising lines from the 1960 selection nursery, compared to standard lines regularly grown by farmers. This was conducted on a light sandy soil. The third test was a duplicate of the second but was located on a heavy, tight soil.

The new lines with multiple resistances were not superior to the standard lines in either yield or quality. Although some of these new lines were very promising they were not always uniform in quality performance or in resistance to disease. (Project J-95)

## Physiology and Culturing of Plant Nematodes

The reproductive rate of the stem and bulb nematode, *Ditylenchus dipsaci*, was investigated, using aseptic alfalfa tissue cultures grown on agar media. Addition of plant growth substances to the basal medium (composed of agar-mineral salts, sucrose and vitamins) increased nematode reproduction; 2.5 times as many nematodes were obtained from tissues grown on agar containing

2,4-dichlorophenoxyacetic acid (2,4-D) + kinetin as on the basal medium. Addition of 2,4-D to the medium to stimulate callus tissue formation was the principal factor in increasing reproduction. Large numbers of such cultures are now in use to obtain large quantities of specimens for studies on nematode physiology as related to nutrition and disease processes.



Average per acre losses in grades

Year	Bright		Seconds		Dull Bright		Dull		Tips*		Totals	
	lbs	\$	lbs	\$	lbs	\$	lbs	\$	lbs	\$	lbs	\$
1959	190	146	44	22	3.40	4.40	28	10.40	+6.4	+0.80	259.0	182.00
1960	4	4	35	26	+38.00	+24.00	18	34.00	+10.6	+4.40	8.4	35.60
1961	126	95	26	19	+4.5	8.50	22	27.30	+9.0	+1.20	160.5	148.60
Total	320	245	105	67	+39.1	+11.10	68	71.70	+26.0	+6.40	427.9	366.20

\* + signs indicate that in these grades the plants with tobacco mosaic produced more than plants without TMV.

Studies on the mechanism of galling of alfalfa by *D. dipsaci* have revealed that this nematode contains active pectinolytic enzymes, both pectin methyl esterase and polygalacturonase. The polygalacturonase is more active against methoxyl-substituted pectins than sodium polypectate, indicating more of a protopectinase-like activity. Galled alfalfa contains less pectin material than healthy tissues which correlates with the enzyme activity of the nematode. Studies are underway to purify and characterize the nematode polygalacturonase. Such studies provide biochemical explanations of how nematodes cause disease in plants and help us understand these processes better.

(Project J-97)

### Virus Disease and Control Project; Tobacco Mosaic and Tobacco Grades

Field tests on effect of TMV on various grades of tobacco in 1961, as in 1959, were affected by rainfall spread over the summer producing a gradual growth of tobacco. TMV was able to keep pace with growth and caused considerable losses. A summary of the 3-year period 1959, 1960 and 1961 follows:

Results from the 3 years' tests show that growers who consistently have a heavy mosaic crop can lose several hundred dollars per acre over a period of several years.

(Project J-98)

# Control of Root Rots In Decline of Boxwood and Other Woody Ornamentals

## I. Boxwood (*Buxus*)

Two experimental nematocides, DOW M-948 and M-772, show promise in the control of parasitic nematodes on *Buxus sempervirens* var. *suffruticosa* (Figure 1). The M-948 appears to have the long residual effect which would be desirable to the grower because of the reduced labor costs. Plants which had been treated in the spring of the previous year had a lower nematode population than the control plants when sampled one year later. This material, which is an emulsible EDB, is apparently nonphytotoxic to boxwood.

M-773 (emulsible telone) was applied at two rates, 25 ml/plant and 50 ml/plant, and was effective at both rates. This material is low in phytotoxicity. Figure 2 presents a comparison of the results of both materials on the control of *Rotylenchus buxophilus* whereas figure 3 shows a comparison on the control of *Pratylenchus penetrans*.

A study of the effects of environment on the fluctuation of nematodes on boxwood shows an interesting trend in these populations. Figure 3 gives a graphic illustration of the fluctuation

on untreated plants over a period of seven months. Moisture and soil temperature appear to have a direct influence on this fluctuation. Air temperature apparently has no direct effect on the nemas. (Project J-99)

## II. Yew (*Taxus*)

The only serious problem of yew is a root-rot complex caused by *Phytophthora* and poor drainage or wet conditions. Recently several plants have been selected which have demonstrated a field resistance to this disease. Cuttings have been taken and rooted and studies are now under way to test the resistance of these plants to root-rot. Varieties with resistance to this root-rot complex would be highly valued by both the nurseryman and the layman.

In addition to the resistance studies, field tests are underway to study the effect of liming (raising the pH) on the control of the root-rot disease complex in the nursery. Different rates of ground limestone were added to the soil to raise the pH at approximated 0.5 pH unit intervals. Control of this type would be less costly than fungicide treatments and would thereby be beneficial to the nurseryman. (Project J-99)

## Sweet Potato Resistance to *Fusarium* Wilt

Studies have shown that the foreign introduction PI-153655, "Tinian," is highly resistant to *Fusarium oxysporum* f. *batatas* both in field and greenhouse tests. The variety Porto Rico is highly susceptible to this disease. Investigations have been initiated to determine the causes for these differences in susceptibility.

The high resistance of "Tinian" has been demonstrated since *Fusarium*

colonizes the stem tissue without any wilting effects. It can be reisolated from this tissue and proved pathogenic by inoculation to another susceptible variety.

There is some evidence that host resistance of "Tinian" may be mechanical, not physiological. Cellular extracts from resistant and susceptible hosts are equally a favorable medium for spore germination and mycelial growth, indi-



Figure 1 Top row, fern plants received base nutrient solution with no added boron; plants in bottom row received one-half ppm of added boron.

cating the possible absence of nutritional factors.

No antitoxins have been detected and fresh sap exudate from resistant or from susceptible hosts does not inhibit spore germination. Additional physiological studies are in progress.

If host resistance is mechanical, this may involve the formation of tyloses and vascular occlusions which would prevent extensive penetration of pathogen into host. Comparative anatomical studies of disease histology of resistant and susceptible hosts are in progress.

*(Project J-100)*

### **Boron Requirement Shown by a Fern**

For the first time, the possibility of a boron requirement in the Pteridophytes has been investigated and one member, a *Dryopteris* fern, was shown to require boron. Starting with small sporophytes transferred to same culture with some receiving no boron and others receiving one-half p.p.m. of boron in the nutrient solution, boron deficiency symptoms developed in the former group in about 5 months. Prior to the onset of sporulation, the B-deficient plants became stunted. This was followed by malformations of leaves, death of the terminal growing points and, particularly strikingly, by a drastic reduction in the number of sori (in which the sporangia are located).

The sori which were produced on the leaves of B-deficient plants had either no indusium over the sporangia or only a vestige of an indusium. Some of the sporangia were only partly developed and appeared to contain no spores. As is often the case with higher plants, the onset of B-deficiency was coincident with the onset of reproduction. Therefore, this finding in a fern highlights and extends the significance of boron in the reproductive processes of plants.

*(Project K-8-C)*



Figure 2. Above—Underside of fern leaf of B-sufficient plant showing many sporangia-containing sori. Below — B-deficient leaf, having very few sori.

# DAIRY SCIENCE

Research activities in the Department of Dairy Science involve important phases of both the production and processing of milk and dairy products. Objectives in conducting this research include obtaining knowledge leading to the production of milk in the most efficient manner and providing the consumer with the most nutritious and desirable dairy products.

## Model Systems Used in Study of Oxidized Flavor

The thiobarbituric acid reaction was used to measure reaction rates between ascorbic acid and fat globule membrane material. Results clearly demonstrate the pro- and anti-oxidant effect of variable ascorbic acid concentrations in the reaction resulting in oxidized flavor. Other important variables in the reaction are individual cows, concentration of membrane material, temperature, and processing treatments.

The reaction in the model system is effectively inhibited by metal chelating

compounds; however, addition of copper also has an inhibiting effect. The latter may be the result of the different chemical association of added versus natural copper in milk. Results to date indicate an enzyme-type reaction is responsible for oxidized flavor in milk.

Preliminary results, using continuous electrophoresis, show promise as a means of fractionating the complex structure of the fat globule membrane.

*(Project G-34)*

## Study Flavor Development in Cheddar Cheese

Carbonyl compounds in ripened and unripened cheddar cheese were converted to their 2, 4 dinitrophenylhydrazones by running the derivative reaction directly on the acidified water-cheese slurry for 3 hours at 40° C. The resultant derivatives were extracted with methylene chloride and were made "fat-free" on Celite 545 and Seasorb 43 and alumina columns. The fat-free

derivatives were separated into compound classes using the Celite 545 and Seasorb 43 column. The classes were divided into individual derivatives utilizing acetonitrile and hexane liquid-liquid chromatography. Quantitative concentrations of the isolated compounds were obtained by spectrophotometric analyses.

*(Project G-35)*

## Variations in the Freezing Point of Milk

This investigation was initiated to determine the validity of the use of the freezing point as the official basis for the detection of milk adulteration through watering. The freezing point

technique was used in the study. Blood samples were taken before and after milking from animals maintained under identical conditions. Freezing-point determinations were made on

whole blood, blood plasma and serum and milk. Preliminary data indicate significant variations between the freezing points of the blood, its fractions and milk. These variations, however, were not of such magnitude that the milk would be rejected by control

agencies as adulterated milk. The project will be continued to obtain information on the influence of feeds, level of nutrition, stage of lactation, age, breed and environment on freezing point of cow's blood and milk.

*(Project G-35)*

### **Glucose Metabolism in the Cow**

Glucose utilization in the cow has been studied using radiocarbon labeled glucose in several different measurement techniques. It has been found that cows contain about 80 grams of glucose and use up and renew this

amount about every 100 min. The average rate of utilization of glucose in dry cows is about 0.1 lb. per hour. This amount of glucose provides about three-fourths as much energy to the cow as does acetate. *(Project G-38)*

### **Methane and Carbon Dioxide Metabolism in Cattle**

Studies of carbon dioxide and methane movement from the rumen have been carried out with radiocarbon labeled carbonate in steers surgically prepared to allow separate collection of rumen gases and expired gases from the lung. It has been established that a large percentage of the methane produced in the rumen is being derived from carbonate. More methane is lost

in the rumen gases than is absorbed by the animal and this absorption appears to be a simple diffusion. Generally, more carbonate is absorbed than is lost as  $\text{CO}_2$  in rumen gases and this absorption appears to be a complex process. The relative amount of carbonate absorbed changes with type of feed and this effect is being examined.

*(Project G-38)*

### **Bypass of Forestomach in 7-10-Day-Old Calf**

In an attempt to determine how important the forestomach is to the ruminant, a surgical bypass of the forestomach is being developed. The operation involves anastomosing the cardiac esophageal sphincter to the fundic region of the abomasum (true stomach) without removal of the forestomach, which atrophies. Two calves have survived 8 weeks. Autopsy of these suggested that a minor correction in the surgical mechanics would enable

the operation to be more successful. Work is continuing.

The calves will be used to study ruminant metabolism, especially the drop in the blood glucose associated with the development of the forestomach. Later, the composition of milk, especially the fat fraction, will be studied to learn more about the biochemical contribution of the fermentation in the forestomach to milk synthesis.

*(Project G-39)*

### **High Heat Treatment of Skim Milk and Cottage Cheese Production**

Skim milk was heated to temperatures of 170-190°F. for 5 minutes. The cottage cheeses produced from these

skim milks had high moisture content, low creamability property and short shelf life when developed acidity was



the control basis for manufacture. Preliminary results in similar studies, using acidity solely as the check on culture activity and curd strength as the basis for cutting the curd, indicate that the

difficulties in manufacturing and the defects in the resultant cottage cheeses associated with excessive heat treatment of skim milk can be appreciably decreased and probably eliminated.

*(Project G-40)*

## **Sweetened Condensed Cream Good Source of Fat For Ice Cream**

Early results indicate the use of sweetened condensed cream as a source of fat in ice cream compared favorably with fresh cream and was superior to frozen cream and butter.

The sweetened condensed cream used in the investigation contained approximately 49 percent fat, 27 percent sugar, 6 percent milk solids-not-fat, and 18 percent water. This product can be successfully stored at 40° F. for as long as 6 months.

Under the conditions of this investigation, the ice cream made from frozen

condensed cream, either freshly prepared or after a storage period of 6 months at 40° F., compared favorably with fresh cream as a source of fat in producing desired flavor and body and texture characteristics in the finished ice cream, and was superior to ice cream in which frozen cream and butter were used.

The ice cream made from sweetened condensed cream compared very favorably in storage properties to all other ice cream observed in the investigation.

*(Project G-42)*

## **Role of Saliva in Ruminant Bloat Studied**

The first year of an experiment designed to determine the role of saliva in bloat was completed. For this experiment, both of the parotid salivary ducts were ligated in three sheep, and both the parotid and submaxillary salivary ducts were ligated in three more sheep.

No bloat occurred in either the control or experimental sheep while grazing alfalfa pasture last summer, although the pasture was not too lush. This experiment is being repeated this year with Ladino clover as the pasture.

*(Project GC-45)*

## **Acetate Metabolism in Dairy Cattle**

One of the major sources of energy and of carbon for biochemical synthesis in cattle is acetate absorbed from the rumen. The utilization of acetate by dairy cattle has continued under study. It has been found that cattle utilize acetate at an average rate of  $120 \pm 30$  mg./hr./kg. body weight. Seventy-five percent or more of this acetate is absorbed from the rumen;

the rest is derived from the breakdown of such compounds as fatty acids. This rate of utilization of acetate is much the same as that found in nonruminant animals where almost none of the acetate is absorbed from the digestive tract. It appears that the rate of acetate utilization may have been somewhat greater than average in growing steers.

*(Project G-37, G-46)*

## **Growth Hormone Effects on Acetate Metabolism**

It has been known for several years that growth hormone from the pituitary can bring about a marked increase in milk production. Other studies in various species of animals have indicated that a major action of growth hormone is to mobilize the body stores of fat. It has been shown that this mobilized fat is metabolized, but whether the metabolic rate is increased is not known. Metabolized fat is

changed to acetate, and using techniques developed in this laboratory in previous years, we have measured the effect of growth hormone on the acetate metabolic rate. It was found that growth hormone treatment resulted in an average increase of 25% in the rate of metabolism of acetate. This finding provides excellent evidence that growth hormone acts to increase fat utilization.

*(Project G-46)*

## **Nutritive Evaluation of Forages**

A comparison of the nutritive value of early and late maturing varieties of alfalfa and orchardgrass were carried out with steers. Even though Du Puit alfalfa matures 7 to 10 days earlier than the variety Williamsburg, the digestibility and pounds consumed per day are very similar. In the comparison of S-37 orchardgrass (early) with Potomac orchardgrass (late), the digestibility and intake rate of the early va-

riety is higher when they are both harvested on the same day.

The effect of pelleting alfalfa cut on May 17 and June 16 was studied by feeding to growing dairy heifers. Pelleting increased intake and growth rate with both the early and late harvested alfalfa; however, the increased benefits of pelleting were much greater with the late-harvested hay.

*(Project G-47)*

## **New Fatty Acids Discovered in Milk Fat**

Milk fat has been found to contain approximately 0.1% ketostearic acids. The particular location of the ketone groups on the fatty acid chains has suggested that keto acids may be intermediate in unsaturated fatty acid biosynthesis. Oxygenated fatty acids have previously been thought to be involved

in unsaturated fatty acid synthesis in nature. The nature of the intermediates has been poorly understood, and the discovery of the keto acids may provide a good clue in solving this important biochemical problem.

*(Project G-48)*

## **New Concept on Origin of Some Milk Fat Components**

An identification study of the fatty acids and fatty aldehydes of rumen microbial lipids has revealed striking similarities between some microbial and milk fat components. The branched chain fatty acids and aldehydes which were previously thought to be unique

to ruminant fats have now been shown to be present in rich quantities in rumen microbial lipids. This observation has led to the concept that significant quantities of milk and meat fat are synthesized from rumen microbial lipids.

*(Project G-48)*



## **Tissue Distribution of Radioactive Carbon Labeled Progesterone**

Progesterone, a major hormone of the reproductive process and of mammary gland growth, has not been studied previously to determine the site of tissue uptake. Using the technique of autoradiography, the distribution of progesterone in the tissues of the rabbit has been determined. The tissue distribution appears to vary with

physiological state in the tissues of the reproductive tract and the mammary gland. Mammary gland growth and lactation lead to a large uptake of steroid into the gland tissue. The adrenal, liver and kidney, all exhibit uptake indicative of metabolism and excretion.

*(Project G-50)*

## **Pelleting Hay Affects Milk Fat Composition and Consumption**

Analyses, by gas chromatography, of farm fats showed that the milk fat of cows fed pelleted hay and heated corn contained marked increases in the relative amounts of unsaturated fatty acids and decreases in the saturated acids. A negative correlation between milk fat percent and iodine value was shown.

Although pelleting usually increased the consumption of forages, this was not the case for three of four hays fed to calves from 4 days to 16 weeks of age. Four hays, 2 high quality alfalfa,

a medium-quality timothy, and a medium-quality orchard grass, were compared in the long and pelleted form with and without grain. The grass hays were supplemented with soybean oil meal to make the complete ration 15% protein. Only the timothy pellets proved highly satisfactory as the sole dry ration for young calves, and it is concluded that the addition of grain is a more consistent means of increasing consumption by calves than the pelleting of the forages. *(Project G-51)*

## **Silage as the Principal or Only Forage**

Cows fed corn silage as the sole roughage produced well and gained in weight during a 4-months continuous trial. The addition of 4 pounds of concentrate did not yield as significant an increase in milk production over that produced when the silage was balanced with 9 pounds of protein supplement. There was no significant difference in the feeding value of silage produced from fields fertilized with 200 pounds of nitrogen for each of two years, as compared to that produced in similar fields not fertilized with nitrogen for two years, and the fertilized fields produced only slightly more dry matter. Again, corn silage proved highly satisfactory as the sole source of roughage when properly supplemented with protein.

Direct-cut alfalfa silage, chopped hay, and chopped hay plus ammonium lactate were compared in a study of the effects of chemicals normally present in silages on dry-matter consumption of milking cows. The differences in milk production and dry-matter consumption were slight with the cows fed silage eating the least and producing the most milk, and the cows fed chopped hay eating the most and producing the least. The cows fed chopped hay and ammonium lactate were intermediate in both cases. These differences were not significant, and thus definite conclusions as to the effect of ammonium lactate on appetite can not be drawn.

*(Project G-52)*

## Continuous Cream Cheese Production

A satisfactory cream cheese was produced by the following method:

Sweet cream was standardized to the composition of cream cheese by the addition of low heat non-fat dry milk solids and water. The standardized product was pasteurized, homogenized, cooled to 70° F, inoculated with buttermilk culture and liquid rennet and incubated until the acidity developed

to 0.85%. This sour cream product, to which a stabilizer emulsifier was added, was heated to 160° F. with agitation, homogenized, packaged, and cooled statically. The method eliminates the extremely undesirable "bagging drainage" or "centrifuged drainage" methods presently being utilized in the manufacture of cream cheese.

*(Project G-53)*

## Manufacture of Cottage Cheese Using Curd-Tension Measurement

A standardized method for the manufacture of cottage cheese, using curd strength measurements as the sole basis for cutting the cottage cheese curd, was developed. Trials in which acidity and pH measurement were used resulted in wide variations in the rate, degree and length of cooking necessary. Using the

curd strength method and a uniform procedure of cooking, cottage cheese with excellent flavor, body, texture and creamability properties was consistently obtained. The use of curd strength measurements removed much of the human error from the manufacturing procedure.

*(Project G-53)*

## Summer Annual Pasture for Milking Cows

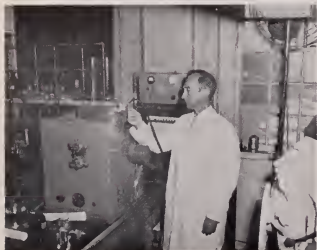
Three summer annual pastures, Sudangrass, pearl millet, and a Sudan-grass x sorghum hybrid, were compared with lactating cows. In addition, two levels of grain were compared.

There was a significant drop in fat percentage for the cows grazing pearl millet. The average change in fat percentage was +0.17% for Sudangrass; -0.17 for pearl millet; +0.02 for the hybrid; -0.11 for the high grain level (22.0 lbs. per day), and +0.09 for the

low grain level (7.6 lbs. per day). Average milk production did not differ for type of forage, but the high grain level group produced 49.6 lbs. milk per day, as compared with 45.3 lbs. for the low grain level group.

Rumen fluid samples were collected for volatile fatty acid determination. The changes in the molar percentages of acetic and propionic acids did not appear to account for the drop in fat percentage.

*(Project BG-2)*



Research results from the Department of Dairy Science are used by industry to improve the usefulness of dairy products. Here, Dr. Mark Keeney, a scientist in the Department, investigates the chemical properties of milk fat.—*Project G-49*

# ENTOMOLOGY

Research by Department of Entomology workers helps to prevent farm losses from insect damage. Prevalence of a great number of insect pests, makes maintenance of control measures extremely complex, involving many technical and practical operations. Research also tackles many fundamental questions, seeking answers that will meet present and future emergencies.

## Systemic Pesticides in Sweet Corn Insect Control

The European corn borer has increased in numbers in the past few years. The losses caused by this increase have stimulated the need for additional research on control of European corn borer. One interesting development in European corn borer control has been with the use of systemic insecticides. With inexpensive equipment attached to the corn planter, granules carrying systemic insecticides have been applied in furrows alongside the seed. The chemical moves into the plant, affording protection from insects, among these, the European corn borer.

Of several insecticides, Cynem, an insecticide-nematocide has given control of first generation corn borer on early planted corn. Not only has it controlled corn borer but Cynem, Di Syston and

phorate have shown promising results in controlling early season pests such as the seed corn maggot and flea beetles that transmit wilt disease.

Heretofore, the research conducted on control of corn earworm has been for large acreage where hydraulic sprayers must be used. There are many small plantings of corn grown for sale in roadside stands, and in home gardens. These growers cannot use large expensive equipment. There are now under observation methods designed for control of earworm which would be suitable for small plantings. Brush-dusting and salt-shaker methods of applying DDT and Sevin are being tested, which if successful will improve methods of controlling corn earworm on a small scale. (*Project H-29-n*)

## Reducing Codling Moth and Mite Damage in Orchards

Work in 1961-1962 on Project H-48 for control of the codling moth, and Project H-69 on identification and control of the various species of mites causing damage to apple orchards consisted of testing equipment and spray and dust formulations. In 1961, two types of machines were used. One was a John Bean airblast machine delivering approximately 62,000 cubic feet of air per minute, which applied material as a

3X concentrate. The other was a John Bean Niagara Model 110 "Cyclone" orchard duster. This machine was equipped with a high-voltage unit, which produced 13,000 to 15,000 volts to the electrodes. During 1962 the airblast machine was replaced with a smaller one of the same make which delivered approximately 24,000 cubic feet of air per minute (figure 1).

In addition to the above equipment,

Figure 1



Air-blast machine applying a 3X concentrate and calibrated to deliver 80 gals. of spray per acre.

Figure 2



Air-blast delivering 8X concentrate to apply 30 gals. of spray per acre.

Figure 3



New electric duster applying approximately 1 lb. of dust to each tree.

an R.S.M. airblast machine designed to deliver 12,000 cfm was obtained through the Blue Ridge Fruit Exchange (figure 2). This machine manufactured in Denmark had special nozzle arrangements to apply up to 10X concentrates without clogging. The dust machine used in 1961 was replaced by a Johnson electric duster (figure 3). It was equipped with an electrical unit that produced 12,000 voltage at 1 micro-ampere of current and derived its power from either a 6- or 12-volt battery.

The spray experiments were set up in two orchards; one 7 and the other 15 years old. The R.S.M. machine was calibrated to apply 30 gallons of 8X concentrate per acre on the 7-year-old trees, and 40 gallons per acre on the 15-years-old block. The John Bean machine was calibrated to apply 80 gallons of the 3X concentrate per acre on the 7-year-old trees and 106 gallons on a 15-year-old block. Using these calibrations, each machine would apply the same amount of toxicants per acre. The dust experiments were in a block of 15-year-old trees, and the machine was calibrated to apply 1 pound of the dust mixture per tree. The dust was applied between 5 and 7 a.m. and another application during the middle of

the day. All plots were treated with the same toxicants applying a charged and regular formulation at each period.

If the low-gallonage and higher concentrations application should prove equal to the dilute applications in producing fruit of high quality, it would be of great economic value to the fruit grower.

For instance, 100 gallons of an 8X concentrate will cover the same number of acres as 800 gallons of a dilute mixture. The cost of equipment, maintenance and operation would be far less than with a conventional type of sprayer. The dust equipment would have similar and greater advantages if it could be used in a complete program. Many of the questions now poised will be partially or completely answered by the end of the current season.

Without going into results to date, it is safe to say that up to the present the equipment using the 8X concentrates compares favorably with the equipment using the 3X concentrates. The 3X concentrate is the standard recommendation for the airblast machine at this time. The new dusting equipment shows promise and the experiments with this machine will be continued through 1963.

*(Projects H-48, and H-69)*

## **Forage Crop Insect Investigations**

Studies on the control of alfalfa weevil have shown a number of new insecticides that may be of great importance in the near future. A new compound called Telodrin has proven to be far more toxic to alfalfa weevil than either Heptachlor or Dieldrin. Although Telodrin is closely related chemically to Heptachlor and Dieldrin, it appears to be approximately four times as toxic as either of these compounds to alfalfa weevil. In experi-

mental plots for control of alfalfa weevil larvae, Telodrin at 1 oz per acre gave control equal to Heptachlor at 4 oz per acre. Fall application for alfalfa weevil control with Telodrin at  $\frac{3}{4}$  lb per acre was superior to Heptachlor and Dieldrin at 1 lb per acre. Indications are that a fall treatment with Telodrin as low as 4 oz per acre will give satisfactory alfalfa weevil control.

Label approval for this material has not yet been obtained. *(Project H-71d)*

## Physiology of Insect Reproduction

In studies on the physiology of reproduction in mosquitoes, it has been shown that between 30 and 45 seconds after the male withdraws from the female, the female is able to transfer spermatozoa over a complicated

U-shaped route. This transfer is inhibited by etherizing or chloroforming the female. The transfer is greatly increased by subjecting the female to carbon dioxide.

(Project H-72)

## Hatching Stimulus of Mosquito Eggs

Two freshwater mosquito species, *Aedes canadensis* and *A. trivittatus*, are noxious pests in certain parts of Maryland in early spring. The eggs of these species (like most *Aedes* spp.) are deposited in relatively dry places that are subsequently flooded. The embryos within these eggs remain dormant or in a state of diapause for many months. The eggs hatch in response to flooding with water having a low oxygen content and in response to temperature. Studies were conducted to obtain a better understanding of the hatching stimulus or how the embryo responds to various environmental conditions, particularly cold. Also it was planned to get information about the number of generations per year. These investigations were made possible by the use of the Illinois Egg Separator, a machine which separates mosquito eggs from dead leaves, soil or "duff" where females had oviposited.

*Aedes canadensis* eggs which were flooded immediately after processing and maintained at room temperature failed to hatch after 5 weeks of continuous flooding. If similar eggs were subjected to freezing temperatures (0° F.) for 1 to 3 days, about 25% of them hatched. On the other hand, prolonged exposure to subfreezing temperatures caused a high rate of mortality of the embryos.

With both *Aedes canadensis* and *A. trivittatus* it was found that alternate flooding and chilling at 40° at weekly intervals had practically no effect after the second flooding. In other words, very few eggs hatched following third, fourth, and fifth floodings but the embryos remained viable. This was generally true even though there was a variation in the duration of exposure to freezing and chilling prior to flooding.

Eggs of *Aedes trivittatus* subjected to 0° F. for prolonged periods responded, when flooded, with good hatches and showed no evidence of entering a firm diapause. When eggs were subjected to 40° F. for 119 days, before flooding, the hatch obtained was good. However, when eggs were subjected to 75° F. for 126 days, before flooding, there was a marked reduction in hatch. This indicated that prolonged exposure to 75° F. had instilled a firm diapause which could not be easily broken. Prolonged exposure to heat and not cold appears to be important in inducing a firm diapause. Eggs at colder temperatures appear to possess a factor which predisposes the eggs to hatch. The voltinism of *A. trivittatus* was not fully ascertained.

(Project H-73a)

## Comparative Morphology and Physiology of Insect Blood Cells

In studies on the comparative morphology and physiology of insect blood

cells, it has been found that the blood-cell count of the bug *Rhodnius* is sig-

nificantly depressed after these animals feed on rabbits. The counts are greatly affected by differences in technique: untreated v. heat-fixed, small punctures v. large punctures, fasting v. well-fed insects.

In the American cockroach, there are about 16 million blood cells in circulation. There is a striking decrease in the relative count when the cockroach

sheds its skin. This has been shown to be due to a sudden and significant increase in the blood volume. It may be that this extra fluid in the blood comes from the absorption of the moulting fluid. At the time that the cockroach sheds its skin its blood has much more coagulation of the plasma.

*(Project H-76)*

## **The Susceptibility of the Red-Banded Leaf Roller to TDE**

When TDE failed to give adequate control of the red-banded leaf roller in several Maryland orchards, an investigation was undertaken to determine the susceptibility of this insect to TDE. Three strains of suspected or known TDE-resistant red-banded leaf rollers were obtained, one each from New York, Virginia, and Maryland, and were reared through 13 generations on Scarlet Runner bean plants. In addition, a TDE-susceptible strain of leaf roller was obtained from an abandoned orchard in which DDT and TDE had not been used for 10 years.

Various dosages of TDE dissolved in acetone were applied topically in 1-microliter droplets to the thorax of fifth instar larvae from each generation of the three resistant and susceptible strains. The apparatus, employed for applying these droplets, consisted of a machinists' micrometer, a tuberculin syringe, and a hypodermic needle. This

was the first time this method was used successfully in determining the resistance of the red-banded leaf roller to TDE.

Results of these tests showed that the Maryland, Virginia and New York strains were 6.7 to 13.3 times more resistant to TDE than the TDE-susceptible strain. Based on these data, it would require between 10 and 18 pounds of 50% TDE per 100 gallons of water to kill 50% of the fifth instar larvae of the three resistant strains. The present standard recommendation for control of the red-banded leaf roller in Maryland orchards is 1 pound of 50% TDE per 100 gallons.

Maryland orchardists who encounter difficulty in controlling the red-banded leaf roller with TDE should assume that resistance has developed and switch to some other insecticide for control.

*(Project H-77)*

## **Metabolism of Nutrients and Insecticides in Insects**

Research on the insect mechanisms responsible for immunity to pathogens has implicated the proteins involved in melanin formation. Experimental evidence accumulated so far all points to

the melanization phenomenon in insect blood as being the same system that destroys infectious bacteria. If this is ultimately proved, then the biological importance of melanin and associated



quinones will have been enhanced considerably. At present melanin is known to be a primary defense against infection in insects by virtue of its role in scar formation on the insect cuticle. Many quinones are known also as defensive repellents actually ejected by certain insects.

Studies on the influence of the pro-

thoracic gland on blood protein of the American cockroach have shown that the removal of this gland slightly alters the quantity of one of the blood proteins. The significance of this observation is not apparent, and it awaits further more discerning work.

*(Project H-78)*

## HOME ECONOMICS

Measures of air permeability are important in the studies of fabric performance. Information on the relation of the air permeability of clothing to comfort has been gathered over a period of three years. The influence of soft and hard fats and various amounts of protein on any increase of cholesterol also is being studied.

### **Measure Air Permeability of Clothing**

The Department of Textiles and Clothing, College of Home Economics, has completed measurement of the air permeability of the 36 shirts and 36 slips used in the wear study for the regional textile project NE-19. The men's white dress shirts in this study are of 3 different types: broadcloth, oxford cloth and wash-and-wear percale. The ladies' white slips include acetate taffeta, nylon tricot and dacron-nylon-cotton batiste. All of these articles were worn by participants at co-

operating stations, New York, Pennsylvania, and Rhode Island.

Air-permeability measurements were made after wear periods in three successive years. These data will be combined with data of other fabric performance measurements at the cooperating stations in an effort to relate air permeability to comfort and other qualities of the fabrics.

A cooperative publication is forthcoming.

*(Project Y-2)*



## Effect of a Low-Fat Diet on Cholesterol of College Women

"The free-for-all debate on unsaturated (soft) and saturated (hard) fats, their influence on the amount of cholesterol in the blood stream, and the effects of even a slight increase of cholesterol on the arteries and heart is befuddling, sensational and frightening." This statement by Gaynor Maddox in Food and Nutrition News is all too true.

The following experiment was undertaken to clarify some of the existing data on the influence of diet on cholesterol of the blood. Recent research has shown that the kind and amount of protein as well as fat and carbohydrate affect the level of serum lipids.

One diet of the 8-week metabolic experiment being reported here combined the factors found by a number of workers to lower serum cholesterol; namely low but adequate protein including low methionine (an essential amino acid containing sulfur), low fat, low cholesterol and high carbohydrate from fruits and vegetables. The other diet was similar, but vitamin-free casein was added to make the diet high in animal protein.

The diet contained a variety of fruits, vegetables, cereals, bread and steak. It did not contain eggs or milk, although it was adequate in protein (by nitrogen balance), minerals and

vitamins. The casein for the high protein diet was incorporated in a number of the recipes such as gingerbread, sauces, date bars and beverages, but most of it was served as a candy which the subjects ate between meals.

The fat in both diets was 25% of the total daily calories and was approximately 66% hydrogenated, being crisco and margarine. The saturated fats were 17 and 24 gm in the low and high protein diets, respectively; and the unsaturated fats were 40 and 45 gm, respectively. The linoleic acid content was 3.0 and 3.6 gm; the cholesterol content was 116 and 164 mg, respectively. Two-thirds of the daily calories were from carbohydrate; 35% of which was from sucrose. Since the diet consisted mostly of natural foods with a variety of fruits and vegetables, it also contained a large amount of pectin.

There was no significant difference between the mean cholesterol values of the low-protein diet group and those of the high-protein diet group at any sampling time. The over-all total fasting serum cholesterol for the low-protein diet group was 182 mg %; for the high-protein diet group it was 179 mg %. These figures are well within the normal range for all subjects on both diets throughout the experiment.

*(Project Y-2)*

# HORTICULTURE

Horticultural research has the twofold aim of bringing the producer his just rewards and the consumer the products of the farm in satisfactory quantity, high quality, and within his means.

The research program thus involves studies ranging from plant breeding to the canning and freezing of fruits and vegetables, carried on in the laboratories and greenhouses at the University, on the experimental farms and on the farms and orchards of cooperating growers throughout the state. Some of the recent results of the research program are briefly presented herein. Scientific and popular articles are released by the Experiment Station.

## **Forcing Temperatures Affect Keeping Quality of Poinsettias**

Bracts of the poinsettia remained longest on those plants which had been growing during the last 4 weeks in the greenhouse at a cool (55° F.) temperature, while the leaves remained on plants longest on those grown at a warm (70° F.) temperature. The temperatures in the earlier part of the

forcing period were less important in influencing this keeping quality than the temperatures in the later periods. A constant uniform soil moisture, such as that supplied by a wick-watered pot, was favorable to both bract and leaf retention on the poinsettia.

*(Project I-74-A)*

## **Growth-Shortening Compounds Act on Ornamental Plants**

A growth-shortening compound tested as CCC [(2-chloroethyl) trimethylammonium chloride] effectively shortened the growth of poinsettia stems without reducing the size of the flower bracts of the leaves. The effective concentration was 2.4 grams of CCC per liter, watered on the soil. This reduction in height was effected by shorter internodes. At higher concentrations there was a reduction in the bract size.

On chrysanthemums, the shortening compound that was effective in short-

ening the plant height is known as phosfon (2,4-dichlorobenzylthributylphosphonium chloride). This shortening compound reduced the height without affecting the size of the flowers, although flowering was delayed 7 to 10 days.

Both shortening compounds checked the vegetative growth of azaleas and favored earlier initiation of flower buds, but they required a longer forcing period than untreated plants.

*(Project I-74-A)*

## **Phosphorus and Potassium Affect Flowering**

Increasing amounts of phosphorus fertilizer produced an increase in the growth and quality of chrysanthemums, marigolds and zinnias. Plants to which increasing amounts of potassium fertilizers were added produced similar but less striking growth increases. Plants in this study were grown in the greenhouse in a mixture of equal parts of loam soil and sphagnum peat to

provide uniform soil conditions.

Cuttings of chrysanthemums taken from plants growing under these fertilizer conditions produced the heaviest root system from plants receiving the larger rates of phosphorus fertilizers. There was no marked response in rooting from the additions of the potassium fertilizers.

*(Project I-74-B)*

## **New Red Sports of Delicious Apples Fruited**

Of the 20 new red sports of Delicious apples now being offered by fruit tree nurseries, nearly half have been fruited in a Maryland test planting for as long as three seasons. Of the "regular" group, Red King has been outstanding at College Park and Hancock, but Royal Red has been good in western Maryland only. Several, including Hired, have been found to be unsatisfactory under Maryland conditions.

The "spur-type" sport of Red Delicious has been of greatest interest among fruit growers. This mutation resulted in not only a higher red color of the fruit, but also in a different vegetative growth habit of the tree, in that internodes were considerably shorter and the limb carried many more fruiting spurs than have ever been known for the Delicious variety. All three commercially available "spur-types" have

been included in Maryland tests on three different rootstocks: standard (seedling), semidwarf (Malling VII), and dwarf (Malling IX).

Evidence after 4 years indicates that under no circumstances should a "spur-type" Delicious be worked to any kind of dwarf rootstock. Such combinations under Maryland conditions simply do not grow, and although flower buds develop early in the life of the tree, they must be destroyed, since the tree is not large enough to carry a crop of apples. Present indications are that "spur-type" trees on seedling roots will produce satisfactorily in Maryland, but only when planted on deep soil, and not when planted on shallow land that is likely to be deficient in moisture for a part of the growing season. (See next page.)

*(Project L-73)*

## **Apple Orchards no Longer Need the Man with the Hoe**

Keeping weeds and grasses away from the trunks of fruit trees is a perennial problem for the fruit grower. Such vegetation competes with the trees for moisture and nutrients, a serious matter especially in young orchards, and affords a haven from which mice can

emerge to girdle trees of all ages. Control of vegetation around young apple trees is now possible by the use of chemicals which have been found to be safe and effective, and for which use labels have been granted by the U. S. Department of Agriculture.

# Caution With Spur-Type Grafts



New "spur-type" Delicious sports grafted to dwarfing rootstocks make unsatisfactory growth. Upper: 1(left) "spur-type" Delicious on dwarfing M 9 interstock; 2(right) non "spur-type" on same stock. Lower; 3(left) "spur-type" Delicious on semi-dwarfing M 7 rootstock; 4(right) non "spur-type" on same stock. All trees 4 years old.



Early fruiting of apples on dwarf stocks can destroy tree shape. Photo shows Golden Delicious on Malling VII rootstock. It was allowed to fruit heavily in the third year.

In 4 years of extensive experiments in western Maryland, dalapon, amino triazole, and simazine have emerged as the most suitable compounds for use in orchards. Under certain conditions one of these chemicals may give excellent control, but where various species of

mice are present a combination of all three has given the best results. A circle 6 feet in diameter can be treated at a cost for chemicals of approximately 2 cents per tree to provide control of surface vegetation for an entire growing season.  
*(Project L-74)*

### **Forcing Hydrangeas**

A higher percentage of flowering shoots with larger inflorescences were produced on plants grown in the greenhouse at a cooler temperature (54° F.), as compared to those grown at a higher temperature (75° F.). This was found to be the case for the 3 varieties—Merveille, Todi, and Rose Supreme. The development of the inflorescence was delayed or inhibited on plants stored at 36° F., at compared to 46° F. The average number of branches in the inflorescence was greater in those plants stored at the

46° F. temperature, which meant that the flowers were larger than on plants stored at 36° F.

This study has shown that the problem of failure to form flower buds or to form only small ones, due to a lack of branches, may be related to extremes in storage temperature and/or in initial forcing temperatures. A storage temperature of 46° F. and initial forcing temperature of 50 to 66° F. would be most favorable for the maximum number and size of flowers.

*(Project I-79-K)*

### **Effect of Vining Method on In-Plant Labor Requirements and Quality of Processed Lima Beans**

With the introduction of mobile viners for peas and lima beans, processors have been concerned about differences in vining costs and effects upon raw-product quality, as compared with stationary viners. Research on field operating costs indicated that savings might be realized with some models of mobile viners. The study reported here was undertaken to determine whether there might also be some differences in the cost of processing beans or in the quality of the finished product due to differences in the vining efficiency of the two methods.

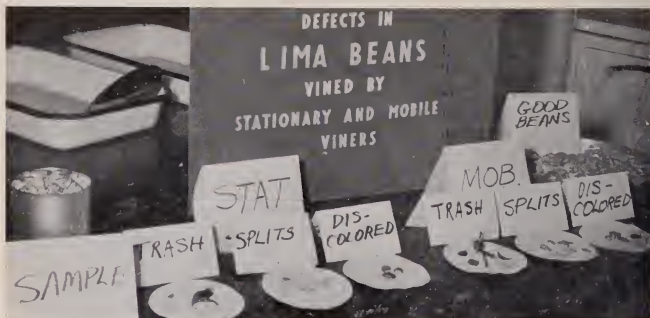
Lima beans were selected for the study because processors felt vining methods might differ in their efficiency of removing discolored beans, which are a problem when fields are wet.

Each participating canner and freezer arranged to harvest half a field with each vining method on a given

day. Samples of lima beans were taken at each stage—raw product, after each cleaning operation, before and after the inspection table, and the finished product. Each sample was examined for count and weight of trash, split or broken, discolored, and overmature beans.

Findings of the first year's phase indicate that there was no significant difference in the amount of extraneous matter and defects in beans vined by each method after undergoing the various cleaning and washing operations. Although lima beans vined by mobile viners contained more trash, most of this material was removed by the first dry-cleaning machine.

There was no measurable difference in labor required at the inspection table to remove defective beans and trash from lots vined by each method. Government graders inspected samples of



In a rotation of visits to plants of six processing firms, 767 samples of lima beans were collected to check contents for defects.

canned and frozen lima beans vined by each method, but no consistent differences in grade were found.

In the second phase, participating processors will draw a sample, after washing, from each field lot of lima beans processed during the season. The

count and weight of trash and discolored beans will be obtained, and results will be compared for processors using each vining method. Also, the value of finished product per dollar of raw-product cost will be compared by vining methods. (*Project QA-58-s*)

## Developing Firmness in Apple Slices

Firmness and changes in chemical composition of apples were tested in the laboratory to supply needed information to the processors. Golden Delicious, Stayman and York Imperial varieties were harvested at 4 stages of maturation; they were processed immediately after harvest placed in cold storage and then processed after 25, 50, 75 and 100 percent of their average expected storage life. The commercial vacuum-steam procedure was used for processing the fruit.

A processor may check the starch content of the raw fruit as a guide to the firmness quality of the processed fruit. High starch content fruit many times is lower in firmness quality than those fruits which are processed just as

the starch is being dissipated from the tissue. After starch has disappeared from the tissue, fruit needs traces of Calcium (Ca) salts to improve the textural quality. Further studies of the use of Ca salts in firming apple slices are anticipated.

(*Project Q-58-p*)



Cyclamen grows best in soils limed so that they are only moderately to slightly acid. The above plants were grown at different soil acidity (pH) values.

# POULTRY

Because of the adaptability of the bird as a laboratory animal, it has been used more than any other "farm animal" in fundamental investigations. As a result, more is known about some fundamental aspects of birds, particularly their nutritive requirements, than is known about almost any animal other than rats and mice. Research in the poultry field has always been a useful combination of fundamental and applied work aimed in the general direction of economic problems. The research outlined below follows this general pattern.

Each year we add to the sum total of knowledge of man about himself and his surroundings. This ultimately enables him to more adequately control the factors with which he works. In poultry research, there has been a gratifying result of the effort expended, in that poultry meat and eggs are now available to the consumer at continually lowering relative prices. The research laboratories and field stations of the Poultry Department are always open for inspection, and we are always glad to discuss with interested parties our current research program.

## **Alkaline Phosphatase of the Blood of Birds**

Alkaline phosphatase is one of the many enzymes that influence metabolic pathways in living tissue. It is an enzyme whose concentration can be rather easily determined and one that appears to be quite important in metabolic processes. It was thus selected as a criterion of selection to produce lines that were high and low in reference to their blood alkaline phosphatase. The selection has been continued for three generations and the average serum alkaline phosphatase level is approximately three times as high in the high line as in the control line. More experiments have been conducted on the physiological basis for the difference between the lines.

Fasting for one day markedly increased the phosphatase content of the kidneys of both lines, but had no effect on the level in the small intestine. Feeding fat to fasted birds had no effect on the kidney phosphatase. Some differences have been found between lines in the susceptibility of the serum phosphatase to various phosphatase inhibitors. On the basis of reciprocal crosses, gene action in respect to serum phosphatase appears to be additive and autosomal. To date no real marked important relationships have been found between alkaline phosphatase and economic characters.

*(Project M-32-m)*

## **Genetic Control of Serum Cholesterol**

Cholesterol is known to be one of the important chemical constituents of all animal tissue and it has received much attention because of its reputed associa-

tion with atherosclerosis. Cholesterol is relatively high in the yolk of eggs. Several years ago this project was initiated to determine the effect of breeding



for high and low serum cholesterol lines. Such lines have been established through five generations of selective breeding. These lines are being studied for their serum cholesterol level, performance, egg quality, mortality, yolk cholesterol level, and blood pressure.

Matings were made in March 1962 in an attempt to further widen the difference between the two lines. Birds of the fifth selected generation were chosen on a family and individual basis and an average of 15 males and 33 females mated together per line. The families were selected according to the serum cholesterol level of the females at 6 weeks of age. At this age the serum cholesterol for the females of the parental high and low lines was 126.7 and 96.1 mg./100 ml., respectively. At 8 months of age, the level of serum cholesterol for these females was 96.4 and 72.9 mg./100 ml., respectively.

The data to date indicate that there is little direct relationship between serum cholesterol level and economic traits, and therefore this criterion would be of little use in a practical breeding program. The results are of theoretical interest, though, in that they shed new light on the distribution of cholesterol within the bird and prove beyond a doubt that levels of cholesterol within blood serum can be markedly altered.

Studies of the distribution of cholesterol in different tissues of the body indicate that the liver is probably one of the organs which removes cholesterol from the blood. However, there seems to be no difference in the two lines with respect to the liver's activity in cholesterol control. Fecal secretions of cholesterol breakdown products were somewhat higher in the low cholesterol line.

*(Project M-33-e)*

## **Protein and Amino Acid Requirements of Laying Hens**

Continued studies on the protein and amino acid requirements of laying hens show that corn-soybean meal rations or rations containing corn, soybean meal and 5% fish meal may contain as little as 12.5% protein and still support egg production equal to that obtained with higher levels of protein with both floor-pen and cage-housed layers, provided that ample quantities of the first limiting amino acid (methionine) is included in their feed. Rations containing 11.2 to 11.8% protein failed to support normal egg production. Protein intake as low as 13 grams per hen per day, as compared with approximately 18 grams normally required, was adequate for high-producing laying hens in this work.

Other tests, involving further reduction of protein content in relation to dietary energy and other nutrients and amino acid supplementation, indicate that lysine and tryptophan are second and third limiting amino acids in corn, soybean meal, fish-meal protein mixtures. Such low protein diets have been rendered entirely adequate, as measured by egg production, by the addition of combinations of specific amino acids. These studies reveal that considerable improvement in protein efficiency of laying hens can be achieved through the formulation of rations containing the proper balance of amino acids.

*(Project M-35-m)*



## Methionine Balance Study with Laying Pullets

A detailed study of the methionine needs of laying pullets maintained in cages for 36 weeks has revealed that 0.9 mg. of methionine per kilocalory is sufficient to support normal egg production (69%) and adequate nitrogen retention (776 mg. per hen per day). Although all hens showed a withdrawal

of body nitrogen as egg production progressed, no greater withdrawal was noted when low-protein diets were fed. In this work, up to 75% of the dietary methionine and 40% of the dietary nitrogen were recovered in the egg protein.

(Project M-35-m)

## Microbiological Studies Pertaining to Poultry Nutrition

Several drugs, such as Mer 29 (triparanol recently withdrawn) and benz-nalecene, have been shown to reduce the level of cholesterol in the blood of humans and animals. These drugs also inhibit the growth of the protozoan microorganisms *Trichomonas gallinae* and *Tetrahymena pyriformis*. The toxicity of these drugs for the latter organism may be overcome by oleic acid, an un-

saturated fatty acid found in many foodstuffs. However, oleic acid does not overcome the toxicity of these drugs for the *Trichomonas* organism which requires cholesterol, as well as oleic and palmitic acids, for growth. Further study on the action of these drugs on protozoa may give a hint as to how the drugs act in humans in lowering blood cholesterol.

(Project M-48)

## The Effect of High Temperature on Shell Thickness

Previous work on this project indicated that both the acidity, (pH) of the blood, and its reserve capacity to neutralize acidic and basic products of absorption and body processes (the so-called "acid-base balance") may influence shell thickness. No dependable methods were available for determining either of these properties and emphasis has been given to developing suitably precise procedures for this purpose.

In other works, preliminary tests have shown that exposure of laying hens to a high CO<sub>2</sub> environment resulted in decreased shell thickness, and that following such exposure there was a shell-thickness "rebound" of short duration which was accompanied by an increase in egg production. These results require further study and confirmation.

(Project M-53)

## Poultry Color Preferences

Now that the poultryman has learned to crowd more layers into a smaller amount of space and to overcome the resulting burden on the ventilating system, there is created a number of additional problems. Data taken by the Poultry Department indicate that when

layers are crowded, they do not travel as far or as frequently in a pen as when there is more room. This is, of course, as one would expect. The poultryman, therefore, must provide an environment in which, despite crowding, the chicken will be able to find feed, water, and a

place to lay her eggs without undue difficulty. In this situation, the nest is very important because the layer must be able to find it, get to it easily, and be attracted to it in order that the eggs will be deposited in the nest. If she will lay her egg in a suitable nest, she has performed an act which permits any amount of mechanization of egg handling we desire. If the management is not satisfactory, the percentage of floor eggs will rise to 10 or more percent of all eggs laid. Floor eggs are usually soiled and also increase labor.

One of the projects which has been under way for a few years is of fundamental interest and involves the color perception and the color preference of the laying hen. A rather high percentage of chickens appear to have a color preference, but there are some breed differences. The present study is endeavoring to influence and heighten this preference to color, hoping that it can be used to make the nest more attractive, thus aiding eventual mechanization.

*(Project M-55)*

### **Causes of Variation in Louse Numbers on Poultry**

It has been observed by students of nature that there are differences in the susceptibility of both plants and animals to the effect of predatory insects. Examples are the resistance of the Zebu cattle to tick-borne diseases and the susceptibility of some humans to mosquitoes and chiggers.

In experiments which have lasted for several years involving individual estimates of the number of body lice found on laying hens, we have been intrigued by the fact that a small number of individuals, possibly 10 percent of the flock, tend to show a consistently small number of parasites. They are in contrast to those in the same pen which may show an enormous number of the

same species. There was nothing about the initial inoculation or the environment to account for these differences; nevertheless, these differences are seen month after month.

The question which presents itself is, why the difference? Two possibilities come to mind at once. One is genetics—some birds may inherit mechanisms which cause the skin to be less suitable as a feeding place for the louse or as a place to live and lay eggs. Another explanation may lie in behavior differences such as dusting or feather preening. In May 1962 an experiment to study this problem was initiated.

*(Project M-57)*

### **Quality Retention in Poultry Meats as Influenced by Methods of Processing**

Work on feather release mechanisms indicates that some areas of the brain may be important as controlling centers for feather release. Most of the work has been centered on equipment for measuring force required to pull feathers out, as well as adequate means of recording this force. At present, a transducer and an automatic recorder are being used. Two areas of the brain

have been located which appear to show some promise.

Review work on this project shows that carcass discoloration is definitely associated with bleeding time. Nearly all discoloration can be eliminated with a proper bleeding time before the bird enters the scald tank.

*(Project M-100)*

## Copper Sulfate Tolerance in Broilers

Up to 300 ppm copper, supplied in all-mash rations as  $\text{CuSO}_4 \cdot 4.5\text{H}_2\text{O}$ , exerted no adverse effects on weight gains or feed conversions of growing broilers, whereas 500 and 1000 ppm copper resulted in growth depressions of 8 and 48%, respectively. In one field trial, where a mild outbreak of chronic respiratory disease was encountered, broilers provided with drinking water con-

taining 50 ppm copper during the period from the 6th to 8th week grew significantly better than controls not receiving copper sulfate. The results suggest that copper sulfate may be used to advantage in disease treatment without adverse effects on growth or feed conversion of healthy birds.

*(Project M-200)*

## Protein Needs of Capons

Rations containing different protein levels were fed to capons for varying periods from the 6th to the 18th week of age, while others were permitted to select their own level of protein by consuming *ad libitum* yellow corn and an 18% all-mash feed. Capons fed rations containing 16% protein from the 6th to the 12th week, and as little as 12% protein from the 12th to the 18th week performed as well, based on weight gain and feed conversion, as did others receiving higher levels of protein. Capons permitted to select their own pro-

tein level consumed rations containing the following levels of protein: 15.4% from 6 to 8 weeks; 14.5% from 8 to 10 weeks; 14.4% from 10 to 12 weeks; 13.3% from 12 to 14 weeks; 13.0% from 14 to 16 weeks; and 12.75% protein from 16 to 18 weeks of age. Growth rate of capons and noncaponized birds was identical during this entire period except for the first 10 days following caponization at 4 weeks. Feed conversions, however, were approximately 10% better for the caponized birds.

*(Project M-200)*

## Amino Acid Requirements of Broilers

Additional trials involving broiler starting and finishing rations containing different levels of protein with and without supplemental methionine, lysine and glycine have been conducted. These have permitted the development of amino acid requirement estimates for broilers as a function of energy content of the ration for use in practical ration formulation. The rations used in these trials involved different levels of fish meal, soybean oil meal, peanut meal, cottonseed meal, corn gluten meal, alfalfa meal and corn as protein sources. Careful analysis of 3 field trials involving starting rations and 5 trials involv-

ing finishing rations reveals that the proposed minimum levels of the critical amino acids, expressed as a function of metabolizable energy content of the ration, were just adequate to support optimum growth. These minimums, however, result in approximately 2% greater caloric uptake than would occur if the levels of the critically limiting amino acids were increased by 6%. Since it would not be economically sound generally to increase the amino acid levels by 6% for only 2% improvement in feed conversion, the Maryland minimum levels of amino acids are considered extremely useful for prac-

tical application. These are given as follows:

### GUIDE FOR MINIMAL LEVELS OF AMINO ACIDS FOR BROILER CHICK-ENS.

Amino Acid	(U. of Md.)		Energy per lb.
	% Amino Acid + Megacalories Metabolizable	0-4½ Weeks	4½-8 Weeks
Methionine		0.28	0.25
Meth. + cystine		0.53	0.48
Lysine		0.80	0.70
Tryptophan		0.16	0.13
Arginine		0.80	0.70
Threonine		0.57	0.49

Phenylalanine	0.55	0.47
Phenylalanine + tyrosine	1.09	0.94
Isoleucine	0.47	0.41
Valine	0.60	0.52
Glycine	0.65	0.56
Leucine	1.09	0.94
Histidine	0.24	0.21

Note: To obtain corresponding values on the basis of productive energy, multiply by 1.43.

Lysine appears to be the second limiting amino acid, after methionine, particularly in broiler finishing rations where lower protein levels are used.

(Project M-202)

### Broilers Need More Riboflavin

Studies involving riboflavin levels at the level suggested by the NRC (1.3 mgs./lb.) showed 20% incidence of "curled toe paralysis" at 2.5 weeks of age. Other broilers fed higher levels of riboflavin failed to show these lesions. The condition corrected itself by the fifth week even though the same ration

was fed. These and other results suggest a marked difference in individual body stores of riboflavin in newly hatched chicks and the need for dietary levels of riboflavin higher than that recommended by NRC for the first few weeks.

(Project M-201)

### Laying Performance of Hens in Floor Pens vs. Cages

Additional comparisons of the egg production of hens fed the same rations but maintained in floor pens or in cages continue to show consistently 6 to 8% poorer egg production for the caged layers. Though certain dietary supplements appeared to be helpful in last year's work, repetition of these variables on a larger scale has failed to reveal any factor which appears to be limiting

in the diet of the hens housed in cages. These supplements have included additional vitamins, minerals, amino acids and supplemental egg yolk. Hence, it appears that some cause other than nutrition is responsible for this better egg production by hens kept in floor pens, as compared with those in cages.

(Project M-202)

### Expression of Amino Acid Requirements for Chicks

Continued studies on the amino acid requirements of chicks, in which nitrogen balance and body composition is determined, have permitted the formulation of equations which express in more basic terms the amino acid needs of growing chickens. These equations relate the requirements to rate of growth, body weight maintained during the period, and the nitrogen content of

the carcass. To date two equations have been developed; one for the threonine requirement and another for total sulfur amino acids (methionine and cystine). These equations permit reasonably accurate appraisals of the requirements of growing chicks for these amino acids where different rates of growth, body weights and body composition are involved.

(Project M-202)

## Function and Requirements for Trace Minerals

**Zinc.** Continued study of the nutritional significance of zinc in poultry feeds has been concerned principally with determining the effect of this element on the performance of mature chickens. Males have been found to reach maturity more slowly on low zinc rations and show a persistence of abnormalities generally similar to those of young chicks, including poor feathering and deformed legs. A new finding has been a severe dermatitis of the comb and wattles which males begin to show as they reach maturity. Zinc-deficient males seldom if ever crow and react to handling in a manner which somewhat resembles that of females. They give sperm, however, which has been found to be of good quality, though sperm production begins at a later age than in cocks which have been reared on adequate zinc intakes. Whether zinc has any really important specific effects on the sex organs of males is not clear, however. All the differences noted so far may reflect only a generalized slow development and lack of vigor and good health in the deficient cocks.

Further tests with mature females

have emphasized the importance of zinc in breeder rations to assure good hatchability and vigorous chicks. The relationship of zinc intake by layers to shell quality of their eggs still remains questionable. As data have accumulated, it has appeared less likely that practical diets would ever be sufficiently low in zinc for the shell quality to be affected.



2 Large cockerel received same diet as dwarfed one, except for 0.001% added zinc. The small cock later developed comb as shown in (1), while comb of other remained clear.



1 Mature cockerel showing comb condition produced by zinc deficiency.



3 Foot-pad condition created by zinc deficiency: (+) zn on right; (-) zn on left. (Birds reared in cages.)

**Magnesium.** Studies with young chicks and turkeys, and with laying hens, have clearly shown the importance of this element for both development and mature performance. It has been found, however, that there is little likelihood of practical rations of the type in general use today being deficient in magnesium. Chicks apparently need no more than 0.03% magnesium in the early fast-growing stage, and poulters no more than 0.05%. The requirement for laying hens in high production seems to be slightly less than 0.10%. Practical diets usually contain 0.15% or more magnesium, considerably in excess of these requirements.

Tests with high levels of magnesium have indicated that concern about the possible toxicity of this element has been exaggerated. Laying hens have been fed a ration containing 0.92% magnesium for a period of 4 months with no apparent ill effects other than slightly moist droppings. Until further

data are accumulated, however, it seems advisable to avoid using high-magnesium limestones to attain the high calcium levels which are frequently being used in layer rations at the present time.

**Calcium and Phosphorus.** Further studies with turkey poulters have confirmed previous data indicating that 2% calcium, the National Research Council recommended level for starting poulters, is much too high. A level of 1.2% calcium has been found to support maximum growth and good bone formation, and further work may show even a lower level of adequacy. A minimum level of 0.7% available phosphorus is recommended for starting poulters. It must be stressed that there is general agreement that total phosphorus values are relatively meaningless. The availability of phosphorus varies in different materials and the essential figure is the level of available phosphorus. (Project M-203)

## **Nutrition and Bone Anomalies in Chicks and Turkeys**

Previous reports have indicated that excess dietary protein aggravates the incidence and severity of perosis in the chick. Continuing work has shown that the folic acid requirement is elevated as dietary protein is added. Folic acid

is used both for body growth and synthesis of uric acid. In this case it appears that folic acid is preferentially used for synthesis of uric acid at the expense of bone growth.

(Project M-204)

## **Implications of Toxic Molds as Related to Poultry**

*Stachybotrys atra* is a mold which grows preferentially on cellulose. It has been reported toxic to large animals. In view of its preference for cellulose, of which litter is primarily composed, it seemed advisable to study its effect on the chick. Studies thus far have indicated that it produces a toxin which destroys the lining of the mouth and crop, thus leaving the tissues open to

infection by other microorganisms. At this time it would appear that crop mycosis of fowl may be induced by toxins such as that produced by *S. atra*.

Other work has indicated that certain of the *Aspergilli* produce a toxin which causes typical hemorrhagic disease in chicks. This toxin could be a causative agent of massive outbreaks of bloodspots in eggs. (Project M-205)



## Ambient Temperature and Broiler Efficiency

Previous studies in commercial-type broiler houses have shown that ambient temperatures as low as 50° F. can be maintained without increasing the food requirement or affecting growth rate. This finding was confirmed again this year in commercial-type broiler houses. Heat was supplied to the houses only when the temperature went below 40° F. Because of the season when the work was carried out, an average temperature of nearer 50° F. resulted. Under the conditions described above, though, there was a very limited amount of stress due to disease conditions, and it is entirely possible that different results would have been obtained if the birds had been subjected to any severe infection.

Work has been initiated to study the influence of controlled temperature and humidity in facilities belonging to the Department of Agricultural Engineering. In these facilities, temperature and humidity can be controlled accurately within the normal range which would be encountered by birds. The birds are grown under standard conditions up to 4 weeks of age before being transferred to these controlled-temperature rooms. Only one study has been completed to date. The facilities worked satisfactorily, but it would be unwise to draw any conclusions from the data secured so far.

*(Project M-301, NE-8)*

## Preservation of Chicken Sperm

With the increased use of artificial insemination in turkey flocks, and an increase in the practice of maintaining chickens in cages, there has been renewed interest in ways of maintaining the fertilizing capacity of fowl semen. One method of preservation which was studied was that of adding compounds to the fowl semen which inhibited its metabolic activity. This is a reversible inhibition, the reversal being effected by diluting out the compound and then concentrating the semen. Twenty-four different compounds were tested for their reversible inhibition, and 11 of them showed some promise.

While in theory this technique has shown promise, in practice it was found that generally the fertility obtained by the semen so treated was not superior to that of the negative control. Different dilution rates during storage and during the washing after storage was studied. The optimum dilution rate for washing was found to be 1 to 4.

The suspending media used in diluting semen obviously has a very pronounced effect on the spermatozoa, and one of the characteristics of the diluent which needs particular attention is the pH, or acidity, of the diluent. Previous work has shown that a pH of 7.2 gives optimum fertilizing ability. Five different buffers were thus prepared which were isotonic and had a pH of 7.2. One of these buffers, sodium tartrate, gave as high a fertility as the phosphate buffer previously thought to be the superior diluent. Two of the buffers; namely, sodium citrate and sodium glutamate, proved somewhat harmful for fertility, and sodium borate and glycine completely inhibited fertilizing capacity.

Studies were carried out to determine the effect of adding dimethyl sulfoxide and xylitol to the semen for purposes of protecting it during freezing. These compounds have been tested because of the toxicity of glycerol to semen. Both compounds were found to offer some

protection against the harmful effects of freezing. However, fertility trials indicated that they were somewhat toxic to semen and were more harmful generally than glycerol which had been used previously.

A study of the effect of the rate at which glycerol is added to or removed from the semen sample indicates that rapid removal of the glycerol by dilution is definitely harmful to the cells. Apparently the glycerol has a temporary osmotic effect in that it passes across the cell membrane rather slowly because of the molecule size, and when

the solution is suddenly diluted with isotonic salt, the cell walls are damaged because of the rapid penetration of water toward the glycerol molecules. Adding the diluent over a 30-minute period improved considerably the results obtained from semen diluted with 8 to 10% glycerol. Data to date indicate that 8 or 10% glycerol is needed to protect the cells against freezing. However, higher percentages might be more advantageous from a protection standpoint if it were not for the toxicity at the higher levels.

*(Project M-302)*

### **Protein Adequacy and Turkey Selection**

This has been the second year of selection of turkeys on the basis of their rate of growth when fed diets adequate in protein or deficient in protein, particularly the amino acids, methionine and lysine. Sixteen pedigree pens were utilized. Full-sib families were divided randomly and assigned to the low or adequate protein diets when 4 weeks of age. Up to this time, they were all grown on an adequate diet. The period chosen for exposure to the experimental diet and the time during which growth would be recorded for selection purposes was the 4- to 8-week period. During this period the protein level was changed in the experimental diet twice. Twenty-week weights were also recorded and at that time the sex of the birds was recorded and related to the previously collected growth data. Selection for this year's breeding stock was made

on the basis of the growth rate during the 4- to 8-week period.

A total of 48 females and 12 males from each line were selected as the parents for the new generation. These birds were maintained in batteries and artificially inseminated. The breeding scheme was so arranged that a minimum of inbreeding resulted. The control and low-protein line poults were grown separately between their 4th and 8th week of age, and growth rate determined during this period of time. Growth rate during this period will be the primary criteria of selection in all subsequent generations. A total of approximately 500 progeny in each line is being grown each year. If the above outlined selection program has the anticipated effect, the birds selected on the adequate protein diet will fatten at an earlier age than the control line.

*(Project M-400)*



# VETERINARY SCIENCE

Veterinary Science brings indispensable services to the livestock and poultry industries. In the College of Agriculture these services are performed by the Department of Veterinary Science and the Live Stock Sanitary Service. Veterinary research projects are chosen on the basis of importance of the disease in relation to the economics of the industries and to the health of the human population. Some research studies are also carried out to determine whether or not full-scale projects are required for the future.

## Respiratory Diseases of Poultry

Modification of the technique of the passive hemagglutination test for the diagnosis of infectious bronchitis of chickens is being studied to improve efficiency of the test. It has been found that treating 8% suspensions of sheep red blood cells with equal volumes of 3% formalin prior to treatment with tannic acid (1:20,000) and sensitization with infectious bronchitis virus greatly reduces elution of virus from the erythrocytes. Free virus eluted from red cells was shown to neutralize antibody and to interfere with the hemagglutination test. The modified test has further been improved by adding 0.3 ml. of 0.3% suspensions of treated and

sensitized sheep cells to 0.4 ml. volumes of diluted positive serum instead of 0.2 ml. as previously practiced. This change in technique is believed to more nearly meet optimal proportions of antigen and antibody. The correlation coefficient by previously employed methods was 0.3 but with modified technique has been raised to 0.8. Virus propagated in tissue culture is believed to be superior to virus grown in embryonating chicken eggs. Cytopathogenic effects have not been noted when infectious bronchitis virus is produced in tissue culture (Chick embryo fibroblasts and kidney cells.)

*(Project D-52)*

## Equine Encephalomyelitis

Research on equine encephalomyelitis in Maryland has involved studies on the ecology of the infection, diagnostic problems, mosquito transmission work, and cross-immunity experiments.

Scattered cases of eastern equine encephalomyelitis (EEE) in equines were observed during the late summer months of 1961, there being only a single isolation made in Dorchester County from the brain of a horse. Surveillance studies in birds and mosquitoes were conducted in collaboration

with WRAIR and the Fish and Wildlife Service. No viruses were isolated from avian hosts. While a number of viral agents were obtained from mosquito pools, none were identified as EEE virus.

Experimental studies on the neutralization of EEE virus has led to improved diagnostic methods resulting in facilitated accuracy in recognition of the disease.

Information obtained from experiments with Group A arbo-viruses in

burros reaffirms the possibility of immunizing against EEE virus with an attenuated strain of Venezuelan equine encephalomyelitis (VEE) virus. Detection of high blood virus levels in west-

ern equine encephalomyelitis (WEE) infected burros yields new information on the possible role of equines in the transmission of the disease.

(Project D-57)

### D-58: Bovine Mastitis

In a study of the interaction of microorganisms, dairy cow and environment, 111 herds representing 4,702 cows (17,208 quarter milk samples) were given stress ratings based upon 38 specific sanitation and milking practices. This was correlated with the frequency of *Streptococcus agalactiae* in quarter milk samples. In this particular group of cows as the number of stresses due to poor milking and sanitary practices increased in the herds the frequency of *Streptococcus agalactiae* also increased.

This means that the dairyman may

help prevent at least some streptococcal infection in his herd by keeping the herd stress low through proper milking and sanitation. Younger cows should be milked first. Two sets of rubber inflation should be alternated weekly. High door sills, rocks, stumps or projecting boards must be removed. Animals should not be crowded. Slow milking is to be avoided. The relative importance of these and other specific factors that may result in herd stress will be evaluated further.

(Project D-58)

### Investigation of "Air-Sac Infection" in Poultry

Air-sac infection in poultry is one of the most serious maladies preying upon the industry. Programs are being formulated currently to detect carriers of the disease and eliminate infection from breeding flocks. In order to obtain data on serological types of the causative organism, *Mycoplasma gallisepticum*, most prevalent in the State, four antigenically dissimilar strains of the etiological agent were employed in an agglutination test on 460 chickens and turkeys in 22 flocks situated in various areas of Maryland. Antigens from strains isolated in this and other states, as well as both pathogens and non-pathogens, were included. No reactions were obtained with nonpathogenic strains and strains isolated in other states. One flock reacted to a pathogenic strain isolated in Maryland. This

data indicates that nonpathogenic strains may not interfere with the detection of carriers of pathogenic strains. Fourteen isolates of *M. gallisepticum*, obtained in this and other states were employed in fermentation studies with carbohydrate media. Six reaction patterns were found.

The object of this phase of the investigation will be to correlate fermentation reactions with serological tests. Fluorescent antibody technique has been applied successfully to the identification of *M. gallisepticum* in tissue smears infected with the causative organism. Such methods promise to shorten the time required to make a diagnosis of the disease. Studies on the physiology of the causative organism have shown that carbohydrates are essential for growth. Glucose, dextrin and

naltose can serve as energy sources. Pentoses, glycerole and most hexoses and disaccharids, other than alpha

polymers of glucose could not be utilized as a source of energy.

(Project D-59)

## Brucellosis

Brucellosis is rapidly being reduced in the United States as a whole. Although the percentage of positive animals found in Maryland is very low, experience has shown that outbreaks of the disease do appear from time to time. The work of this laboratory has been designed to furnish information for the control for such outbreaks, as well as to make a critical study of the agglutination test in order to increase its sensitivity.

Research on brucellosis in the Department of Veterinary Science has concerned itself with the following: (1) development and evaluation of immunizing agents; (2) study of the protective qualities of cattle blood sera; (3) evaluation of Actomer® *in vitro* and *in vivo*; and (4) study of variables in the agglutination test.

Actober® — product of Monsanto Chemical Co.

(Project D-60)

## Liver Composition of Sheep with Pregnancy Disease

Sheep with pregnancy disease usually have a low blood glucose level. This is associated with low concentrations of glycogen, lactate, succinate, fumarate,

and malate in the liver. These results contribute to the understanding of the etiology of ruminant ketosis.

(Project D-61)

## Leptospirosis

Surveillance of normal cattle for leptospiral antibodies using a battery of 11 serotype antigens for "screening" indicated that there had been significant infection involving a number of leptospiral strains other than that for which commercial vaccines are available. Special emphasis has been placed on testing animals from the Harford County area where *Leptospira sp.* had been active in the wildlife population. Antibodies present in bovine serums collected in the area correlated with leptospiral isolations made from wildlife. However, no definitive relationship between *Leptospira sp.* isolated from the wildlife and active disease in cattle was established.

Calves were experimentally infected with *L. canicola* strains to determine pathogenicity and to test Cox-Larson

solid medium as a diagnostic tool. Clinical signs of infection were noted 3-4 days post-exposure. The solid medium did not prove of value in isolating leptospires from the blood.

A second post-vaccination study for leptospiral antibodies was conducted in one of the University of Maryland dairy herds. Animals were bled approximately one year following administration of *L. pomona* bacterin and only 1 animal in the herd of 95 had a significant titer to *L. pomona* antigen. Failure of an animal to develop significant titers after vaccination for leptospirosis does not imply that immunity has not been established. Findings from studies of this nature have proved most useful to officials engaged in regulatory veterinary medicine.

(Project D-62-I)

## Vibriosis

Refinements of filtration techniques for direct isolation of *Vibrio fetus* from carrier bulls have increased the isolation rate from 57% to 80% from samples taken from bulls in studs, on farms and under experimental conditions. An anti biotic medium that did not require filtration of the sample was developed and its efficiency compared favorably with the filtration technique. Over 1000 colony isolations were identified as the pathogenic *Vibrio fetus* Type I without disagreement with the biochemical pattern established for this type. These procedures should help to standardize

the studies of *Vibrio fetus* infections.

It is now possible to detect infections in the principal spreader and carrier of the disease in both bull studs and in infertile herds. There is now additional assurance that the isolations that are made can be identified as pathogenic or non-pathogenic types. Previously the inability to isolate and specifically identify *Vibrio fetus* infection in bulls has hampered progress in controlling and eliminating this infection from bull studs and infected herds.

(Project D-62-II)

## Studies of Bovine Respiratory Diseases

In studies using 44 calves, it was found that exposure to a combination of SF-4 virus and *Pasteurella multocida* resulted in recognizable disease in the experimental animals. Unexposed controls and those receiving only one infec-

tious agent, remained normal.

A total of 12 outbreaks of shipping fever in Maryland cattle were investigated and laboratory tests conducted. IBR virus was isolated from four herds.

(Project D-63)

# STATION STAFF

1961-1962

## Agricultural Economics

J. M. Curtis, Ph.D., Prof. and Head of Dept.  
G. M. Beal, Ph.D., Prof. Agr. Econ.  
R. J. Beiter, M.S., Instr. Agr. Econ.  
P. W. Foster, Ph.D., Assoc. Prof. Agr. Econ.  
Sidney Ishee, Ph.D., Asst. Prof. Agr. Econ.  
J. E. Martin, Ph.D., Asst. Prof. Agr. Econ.  
R. A. Murray, Ph.D., Assoc. Prof. Agr. Econ.  
L. C. O'Day, M.S., Res. Asst. Agr. Econ.  
J. P. Marshall, Ph.D., Asst. Prof. Agr. Econ.  
H. D. Smith, Ph.D., Assoc. Prof. Agr. Econ.  
D. A. Swope, Ph.D., Asst. Prof. Agr. Econ.  
W. P. Walker, M.S., Prof. Agr. Econ.  
J. W. Wysong, Ph.D., Asst. Prof. Agr. Econ.

## Agricultural Education

C. R. Smith, Ed.D., Asst. Prof. Agr. Ed.

## Agricultural Engineering

R. L. Green, Ph.D., Prof. and Head of Dept.  
George Burkhardt, M.S., Res. Prof. Agr. Engin.  
K. E. Felton, B.S., Asst. Prof. Agr. Engin.  
W. L. Harris, Ph.D., Asst. Prof. Agr. Engin.  
P. N. Winn, M.S., Res. Assoc. Prof. Agr. Engin.

## Agronomy

J. H. Axley, Ph.D., Assoc. Prof. Soils  
N. A. Clark, Ph.D., Asst. Prof. Crops  
A. M. Decker, Ph.D., Assoc. Prof. Crops  
J. H. Hoyert, Ph.D., Assoc. Prof. Tobacco  
C. B. Kresge, Ph.D., Asst. Prof. Soils  
R. C. Leffel, Ph.D., Assoc. Prof. Crops  
J. A. Meade, Ph.D., Asst. Prof. Crops  
J. A. Pomeroy, Ph.D., Asst. Prof. Soils  
R. G. Rothgeb, Ph.D., Res. Prof. Crops  
P. W. Santelmann, Ph.D., Assoc. Prof. Crops  
O. E. Street, Ph.D., Prof. Tobacco  
Edward Strickling, Ph.D., Assoc. Prof. Soils

## Animal Science

J. E. Foster, Ph.D., Prof. and Head of Dept.  
John Burie, Ph.D., Asst. Prof. An. Husb.  
W. W. Green, Ph.D., Prof. An. Husb.  
E. C. Leffel, Ph.D., Assoc. Prof. An. Husb.  
E. F. Young, Ph.D., Asst. Prof. An. Husb.

## Botany

Ronald Bamford, Ph.D., Prof. and Head of Dept.  
A. A. Bell, Ph.D., Asst. Prof. Plant Path.  
R. A. Galloway, Ph.D., Asst. Prof. Plant Phys.  
H. G. Gauch, Ph.D., Prof. Plant Phys.  
R. W. Krauss, Ph.D., Prof. Plant Phys.  
L. R. Krusberg, Ph.D., Asst. Prof. Plant Path.  
D. T. Morgan, Jr., Ph.D., Prof. Botany  
O. D. Morgan, Jr., Ph.D., Assoc. Prof. Plant Path.  
R. A. Patterson, Ph.D., Asst. Prof. Botany  
R. D. Rappleye, Ph.D., Assoc. Prof. Botany  
H. D. Sisler, Ph.D., Assoc. Prof. Plant Path.  
J. B. Wilson, Ph.D., Asst. Prof. Plant Path.  
F. J. Williams, Ph.D., Asst. Prof. Plant Path.

## Dairy Husbandry

R. F. Davis, Ph.D., Prof. and Head of Dept.  
W. S. Arbuckle, Ph.D., Prof. Dairy Mfg.  
J. L. Cason, Ph.D., Assoc. Prof. Dairy Husb.  
R. N. Doetsch, Ph.D., Prof. Microbiol.  
R. W. Hemken, Ph.D., Asst. Prof. Dairy Husb.

Ira Katz, M.S., Res. Asst. Dairy Mfg.  
Mark Keeney, Ph.D., Prof. Dairy Mfg.  
R. L. King, Ph.D., Asst. Prof. Dairy Mfg.  
J. F. Mattick, Ph.D., Assoc. Prof. Dairy Mfg.  
W. E. Stewart, Ph.D., Asst. Prof. Dairy Husb.  
J. H. Vandersall, Ph.D., Asst. Prof. Dairy Husb.  
W. F. Williams, Ph.D., Asst. Prof. Dairy Mfg.

## Editorial

Roy E. Miller, B.S. in Journalism, Editor

## Entomology

W. E. Bickley, Ph.D., Prof. and Head of Dept.  
L. P. Ditman, Ph.D., Res. Prof. Ent.  
Castillo Graham, Ph.D., Assoc. Prof. Ent.  
F. P. Harrison, Ph.D., Asst. Prof. Ent.  
J. C. Jones, Ph.D., Assoc. Prof. Ent.  
E. R. Krestensen, M.S., Instr. Ent.  
A. L. Steinhauer, Ph.D., Asst. Prof. Ent.

## Home Economics

Pela F. Braucher, M.S., Assoc. Prof. Foods and Nutrition

## Horticulture

I. C. Haut, Ph.D., Prof. and Head of Dept.  
LeMoyne Hogan, M.S., Instr. Hort.  
W. L. Hollis, Ph.D., Res. Asst. Prof. Veg. Crops  
Amihud Kramer, Ph.D., Prof. Hort.  
C. B. Link, Ph.D., Prof. Flor.  
W. A. Matthews, M.S., Assoc. Prof. Veg. Crops  
C. W. Reynolds, Ph.D., Assoc. Prof. Veg. Crops  
L. E. Scott, Ph.D., Prof. Hort. Phys.  
J. B. Shanks, Ph.D., Prof. Flor.  
R. J. Snyder, Ph.D., Res. Asst. Prof. Veg. Crops  
F. C. Stark, Jr., Ph.D., Prof. Veg. Crops  
A. H. Thompson, Ph.D., Prof. Pomol.  
S. H. Todd, B.S., Inst. Hort.  
R. C. Wiley, Ph.D., Assoc. Prof. Hort. Proc.

## Poultry Husbandry

C. S. Shaffner, Ph.D., Prof. and Head of Dept.  
G. F. Combs, Ph.D., Prof. Poultry Nutrition  
R. D. Creek, Ph.D., Asst. Prof. Poultry Husb.  
N. V. Helbacka, Ph.D., Assoc. Prof. Poultry Mktg.  
G. D. Quigley, B.S., Assoc. Prof. Poultry Husb.  
Mary S. Shorb, Sc.D., Res. Prof. Poultry Nutrition  
W. C. Supplee, Ph.D., Res. Assoc. Poultry Nutrition

## Veterinary Science

A. L. Brueckner, B.S., V.M.D., Prof. and Head of Dept.  
R. J. Byrne, D.V.M., M.S., Assoc. Prof. Vet. Sc.  
S. C. Chang, Ph.D., Assoc. Prof. Virology  
C. M. Cotton, Ph.D., Assoc. Prof. Vet. Sc.  
C. R. Davis, D.V.M., Assoc. Prof. Poultry Path.  
D. M. DeVolt, B.S., D.V.M., M.S., Prof. Avian Path.  
B. C. Hatzios, D.V.M., D.A.H., Assoc. Prof. Path.  
R. B. Johnson, A.B., Assoc. Prof. Vet. Sc.  
J. D. Kornder, B.S., M.S., D.V.M., Asst. Prof. Vet. Sc.  
I. M. Moulthrop, D.V.M., Prof. Path.  
G. J. Plumer, B.S., D.V.M., Assoc. Prof. Path.  
D. O. Wiersig, D.V.M., Asst. Prof. Vet. Sc.

# FINANCIAL STATEMENT -- JULY 1, 1961 TO JUNE 30, 1962

## Federal Funds

	Amended Hatch	Regional Research	Agri. Marketing Title II
\$	\$	\$	\$
384,286.00	109,455.00		1,079.55
384,286.00	109,455.00		12,666.00
TOTALS			13,745.55

### Appropriation 1961-1962

TOTALS

### Receipts from sources other than Federal 1961-1962

State Appropriations for Agricultural Investigation	\$1,196,540.72
Special Endowments, Fellowships and Grants	47,803.50
Sales and Miscellaneous	150,248.60
	1,394,592.82
Balance brought forward July 1, 1961	68,063.25
TOTAL	1,462,656.07

For Agri Investigations\*

### Expenditures:

Personal Services	262,548.89	74,572.70	9,793.82	970,476.94
Travel & Transportation of Persons	4,254.49	3,064.46	765.26	19,731.23
Equipment	39,306.36	11,869.67	50.00	33,105.30
Lands & Structures	3,398.68			25,552.55
Personal Benefits				2,317.39
Supplies & Materials	60,367.69	14,140.57	241.76	297,963.10
All Other	14,409.89	5,666.00	1,192.95	80,339.24
	384,286.00	109,313.40	12,043.79	1,429,985.75
Balance June 30, 1962		141.60	1,701.76	32,670.32
TOTALS	384,286.00	109,455.00	13,745.55	1,462,656.07

\*Including Offset Funds.

# PUBLICATIONS

## Bulletins

- 471 Costs, Returns and Profitability of Artificial Hay Drying on Northeastern Dairy Farms. J. W. Wysong. 29 pp. November, 1961.
- 472 Adaptation and Performance of Soybean Varieties in Maryland, 1951-1960. R. C. Leffel and J. L. Newcomer. 14 pp. November, 1961.
- 473 The Competitive Position of Maryland Soybeans. C. C. Taylor and Bhagwant Singh. 73 pp. June, 1962.
- A117 Planting Date and Varietal Effects on Agronomic and Seed Compositional Characters in Soybeans. R. C. Leffel. 69 pp. December, 1961.
- A118 The Technology of Utilizing Concentrated Fruit Juices and Essences in Ice Cream and Related Products. W. S. Arbuckle, William Venter, Jr., J. F. Matlack and N. C. Aceto. 43 pp. December, 1961.
- A119 Duration of Burn of Maryland Tobacco. P. N. Winn, Jr. 47 pp. February, 1962.
- A120 The Effect of Dietary Fat on the Utilization of Low Protein Diets by College Women. Pela F. Braucher. 27 pp. January, 1962.
- A121 Biology and Economic Importance of the Clover Root Curculio *Sitona hispidula* (Fab.) in Maryland. W. G. Phillips and L. P. Ditman. 21 pp. February, 1962.

## Scientific Journal Articles and Miscellaneous Periodicals, Reports, Proceedings, Etc.

### Department of Agricultural Economics

- 439 Area Comparisons in Broiler Production, Price and Feed Relationships. Harold Smith, Norman Helbacka, John Crothers and John Curtis. Multigraphed Circular. 30 pp. November, 1961.
- 440 Area Comparisons in Transportation of Broiler Feed Ingredients and Ready-to-Cook Chicken. Harold Smith and John Curtis. Multigraphed Circular. 25 pp. November, 1961.
- 445 Marketing of Livestock at the Baltimore Public Stockyards. J. N. Smith and H. D. Smith. Multigraphed Circular. 43 pp. December, 1961.
- 448 Caged Layer Operations in Maryland. R. A. Murray. Multigraphed Circular. 11 pp. June, 1961.
- 460 Quality Differentiation Practices of Vegetable Processors. D. A. Swope and F. R. Todd, Jr. Multigraphed Circular. 17 pp. May, 1962.
- 461 Taxation in Maryland with Special Reference to State-County Fiscal Relations. W. P. Walker. Multigraphed Circular. 29 pp. June, 1962.

### Department of Agricultural Engineering

- 452 Supplemental Procedures to Improve Curing of Maryland Tobacco. P. N. Winn, Jr., and J. H. Hoyert. Multigraphed Circular. 7 pp. June, 1962.

### Department of Agricultural and Extension Education

- 443 Progress Report on Study of Student Success in the College of Agriculture. C. R. Smith. Multigraphed Circular. 42 pp. December, 1961.
- 459 Progress Report on Study of Attrition of Able Students in the College of Agriculture. C. R. Smith. Multigraphed Circular. 30 pp. April, 1962.

### Department of Agronomy

- A890 Plant Lodging as a Selection Criterion in Soybean Breeding. R. C. Leffel. Crop Sci. 1:346-349. October, 1961.



- A914 The Effect of Nitrogen Source on Yield and Nitrogen Content of Bluegrass Forage. C. B. Kresge and S. E. Younts. *Agron. Jour.* 54:149-152, 1962.
- A918 Estimates of Optimum Plot Size from Uniformity Data in Maryland Tobacco. J. P. Pointer and E. J. Koch. *Tobacco Sci.* 5:112-117. October 20, 1961. *Tobacco* 153(16):26-31. October 20, 1961.
- A921 Some Effects of Nitrogen Fertilizer, Maturity and Light on the Composition of Orchardgrass. C. H. Gordon, A. M. Decker and H. B. Wiseman. *Agron. Jour.* 54:376-378, 1962.
- A929 Evaluation of Air to Water Permeability Ratio for Measuring Differences in Soil Structural Stability Under Ten Cropping Systems. O. P. Cohen and Edward Strickling. *Soil Sci. Soc. Amer. Proc.* 26:323-326, July-Aug. 1962.
- A937 Effect of Various Rates and Frequencies of Potassium Application on Yield and Chemical Composition of Alfalfa and Alfalfa-Orchardgrass. C. B. Kresge and S. E. Younts. *Agron. Jour.* 54:313-316, 1962.
- A951 A Comparison of Selected Methods for Expressing Soil Aggregate Stability. A. W. Conaway, Jr., and Edward Strickling. *Soil Sci. Soc. Proc.* 26(5):426-430. Sept.-Oct., 1962.
- A952 Variation in the Flow Rate of Granular Applicators. N. C. Glaze, J. A. Meade and P. W. Santelmann. *Proc. N. E. Weed Control Conf.* 16:332-339. January 3, 4, 5, 1962.
- A953 The Response of Nutgrass to Herbicides Applied at Varying Stages of Growth. P. W. Santelmann and J. A. Meade. *Proc. N. E. Weed Control Conf.* 16:321-326. January 3, 4, 5, 1962.
- A993 Effects of Air Pollution, Nitrogen Levels, Supplemental Irrigation and Plant Spacing on Weather Fleck and Leaf Losses in Maryland Tobacco. H. A. Menser and O. E. Street. *Tobacco Sci.* 6:165-169. *Tobacco New York* 155(17):192-196. October 26, 1962.

#### Department of Animal Science

- 438 Effects of Preparation and Quantity of Hay Upon Rumen Acid Production in Sheep. L. W. Smith and E. C. Leffel. 1961. *Proc. N. Atlantic Sect., Amer. Soc. Animal Prod.* 3:31-38, August 22-23, 1961.
- A899 Experimental Production of Bloat with Various Chemicals. E. C. Leffel and R. J. Komarek. *Jour. Dairy Sci.* XLIV:1771. September, 1961.
- A913 A Gas-Tight Cannula for a Rumen Fistula. R. J. Komarek and E. C. Leffel. *Jour. Animal Sci.* 20:782. November, 1961.

#### Department of Botany

- 450 Effect of Fungicidal Sprays on Disease Control and Yield of Tomatoes on the Eastern Shore of Maryland. J. G. Kantzes and L. O. Weaver. *Trans. Penin. Hort. Soc.* 51:18-19, 1961.
- 451 Disease Control of Cucurbits on the Eastern Shore, 1961. J. G. Kantzes and W. A. Matthews. *Trans. Penin. Hort. Soc.* 51:36-39, 1961.
- 456 Studies with Memagon Used as Seed Treatment on Vegetable Seeds for Control of Root-Knot Nematodes. J. G. Kantzes. *Trans. Penin. Hort. Soc.* 51:7-8, 1961.
- 458 Relation of Fertility Levels and Chemical Sprays to Bacterial Spot of Peppers. J. G. Kantzes and F. C. Stark. *Trans. Penin. Hort. Soc.* 51:13-14, 1961.
- A939 Inhibition of Cell-Division by Carbon Dioxide. Constantine Sorokin. *Nature* 194:496-497, 1962.
- A955 Mass Culture of Algae for Food and Other Organic Compounds. R. W. Krauss. *Amer. Jour. Botany* 49(4):425-435, 1962.
- A959 Evidence for a Chemical Basis of Resistance of Lima Bean Plants to Downy Mildew. J. R. Valenta and H. D. Sisler. *Phytopath.* 52:1030-1037, 1962.
- A967 Effect of Fungicides on Permeability of Yeast Cells to the Pyruvate Ion. Margaret Kottke and H. D. Sisler. *Phytopath.* 52:959-961, 1962.
- A972 Carbon Dioxide and Bicarbonate in Cell Division. Constantine Sorokin. *Archiv fur Mikrobiologie* 44:219-227, 1962.
- A974 Effects of Acidity on Cell Division. Constantine Sorokin. *Exp. Cell Res.* 27:583-584, 1962.

## Department of Dairy Science

- A938 An Appraisal of Caryophanon Latum Peshkoff, P. J. Provost and R. N. Doetsch, Jour. General Microbiol, 28:547-558. July, 1962.
- A950 On the Probable Origin of Some Milk Fat Acids in Rumen Microbial Lipids. Mark Keeney, Ira Katz and M. J. Allison. Jour. Amer. Oil Chemists' Soc. XXXIX(4):198-201. April, 1962.
- A954 Acetate Turnover Rate as Determined by Two Superimposed Techniques. Si Duk Lee and W. F. Williams, Jour. Dairy Sci. XLV(4):517-521. April, 1962.
- A969 The Acetate Turnover Rate in the Bovine. S. D. Lee and W. F. Williams. Jour. Dairy Sci. XLV(7):893-896. July, 1962.
- A980 The Composition of Milk Produced on Pelleted Hay and Heated Corn. R. L. King and R. W. Hemken. Jour. Dairy Sci. XLV(11):1336-1342. November, 1962.
- A985 Oxidation of Milk Fat Globule Membrane Material. I. The Thiobarbituric Acid Reaction as a Measure of Oxidized Flavor in Milk and Model Systems. R. L. King. J. Dairy Sci. XLV(10):1165-1171. October, 1962.
- A989 Occurrence of Ketostearic Acids in Cow's Milk Fat: Suggested Intermediates in Unsaturated Fatty Acid Biosynthesis. Mark Keeney, Ira Katz and D. P. Schwartz. Biochimica et Biophysica Acta 62:615-616. 1962.

## Department of Entomology

- 408 Lagoons for Sewage, Other Wastes—and Mosquitoes. W. E. Bickley and Jerry Mallack, Proc. 29th An. Conf. Cal. Mosquito Control Assoc. pp. 152-153. 1961.
- 414 Laboratory Studies on the Potentialities of Some Herbicides as Mosquito Larvicides. Jerry Mallack. Proc. N. J. Mosquito Extermination Assoc. 1961. pp. 178-181.
- 418 Dibron as an Adulticide for Mosquito Control. Jerry Mallack, L. A. Kulp, S. R. Joseph and R. A. Berry, Jr. Proc. N. J. Mosquito Extermination Assoc. 1961. pp. 183-185.
- 422 Some Results on Insecticides Used as Mist Sprays for Adult Mosquito Control. S. R. Joseph, R. A. Berry, Jr., L. W. Smith and J. C. Mallack. Proc. N. J. Mosquito Extermination Assoc. 1961. pp. 131-134.
- 423 The Masking of Insecticidal Odors in Mosquito Control Sprays. J. C. Mallack, S. R. Joseph and J. R. Foster. Proc. N. J. Mosquito Extermination Assoc. 1961. pp. 181-183.
- 425 Observations on Sexually Depleted Male *Aedes aegypti* (L.). J. C. Jones. Amer. Zoologist p. 362. August, 1961.
- 431 *Aedes thibaulti* in Maryland. S. R. Joseph. Mosquito News 21(3):251-252. September, 1961.
- 441 Results of Dusts Carrying an Electrostatic Charge and Regular Formulations Against Apple Pests. E. R. Krestensen, Castillo Graham, George McGrew and L. O. Weaver. Trans. Penin. Hort. Soc. 51(5):66-69. 1961.
- 444 Observations on the Structure and Contents of Yellow Jackets' Nest (Hymenoptera). Elizabeth E. Haviland. Proc. Entomol. Soc. of Wash. 64(3):181-183. 1962.
- 446 Changes in the Hemolymph Volume During the Moulting Cycle of *Periplaneta americana* L. R. E. Wheeler. Federation Proc. 21:123. 1962.
- 453 Circulating and Adherent Hemocytes in Unfed and Fed *Rhodnius prolixus* Stal. (Hemiptera). J. C. Jones. Amer. Zool. 2(3):418. August, 1962.
- 455 Control of *Culex pipiens* in a Lagoon Holding Canning Wastes. Jerry Mallack, J. R. Foster, W. E. Bickley and E. C. Weber. Mosquito News 22:106-107. 1962.
- 457 The Black Citrus Aphid, *Toxoptera aurantii* (Fonscolombe), in Maryland. W. T. Johnson and L. M. Russell. Proc. Entomol. Soc. Wash. 64(2):90. June, 1962.
- 463 Contractions of the Antennal Pulsatile Organ of the American Cockroach *Periplaneta americana* L. S. R. Joseph and J. C. Jones. Physiologist 5(3):163. 1962.

- A796 Physiological Studies on the Female Reproductive System of *Aedes aegypti* (L.). J. C. Jones and T. J. Curtin. Proc. 11th Internatl. Congress of Entomol, Vienna, 1960. 2:391.
- A797 The Mechanism of Rotation of the Male Terminalia in *Aedes aegypti* (L.). Proc. 11th Internatl. Congress of Entomol, Vienna, 1960. J. C. Jones and C. J. Hodapp. 1:348-349. 1961.
- A891 Experiments with Granular Systemic Insecticides for Control of Insects on Potatoes, Lima Beans and Sweet Corn. P. H. Schwartz, Jr., C. E. Osgood and L. P. Ditman. Jour. Econ. Entomol. 54(4):663-665. August, 1961.
- A904 The Anatomy of the Adult Male Reproductive System of *Aedes aegypti* (Linnaeus) (Diptera, Culicidae). C. J. Hodapp and J. C. Jones. Annals of Entomol. Soc. of America 54(6):832-844. November, 1961.
- A906 Hog Lice Control by Ground Treatment. W. T. Johnson. Jour. Econ. Entomol. 54(4):821. August, 1961.
- A908 Current Concepts Concerning Insect Hemocytes. J. C. Jones. Amer. Zoologist (Abstract) 1:362. August, 1961.
- A927 Current Concepts Concerning Insect Hemocytes. J. C. Jones. Amer. Zool. 2:209-246. 1962.
- A946 DDT Susceptibility of *Drosophila melanogaster* Meig. in Relation to Dietary Amino Nitrogen. C. T. Rivera and A. L. Steinhauer. Jour. Econ. Entomol. pp. 393-395. June, 1962.
- A957 A New Chelonus from Western United States (Hymenoptera: Braconidae). C. W. McComb. Proc. Entomol. Soc. of Wash. pp. 19-20. 1962.
- A958 The Control of the Green Peach Aphid of Tobacco with Systemic Insecticides. L. B. Savage and F. P. Harrison. Jour. Econ. Entomol. 55(5):623-626. 1962.
- A962 On the Control of Corn Earworm, *Heliothis zea* (Boddie), and Dusky Sap Beetle, *Carpophilus lugubris* (Murr.), in Sweet Corn. F. P. Harrison. Jour. Econ. Entomol. 55(5):671-674. 1962.
- A963 New Insecticides for Pea Aphid Control. L. P. Ditman. Trans. Penin. Hort. Soc. 51(5):25. 1961.
- A965 Experiments on Alfalfa Insect Control in Maryland. A. L. Steinhauer, C. C. Blickenstaff and V. E. Adler. Jour. Econ. Entomol. 55(5):718-722. 1962.
- A976 Observations on the Infestation of Sweet Corn by the Dusky Sap Beetle, *Carpophilus lugubris*. F. P. Harrison. Jour. Econ. Entomol. 55(6):922-925. 1962.

#### Department of Horticulture

- 410 Yield and Fruit Size of York Imperial Apple Trees as Influenced by Six Years of Chemical Thinning. B. L. Rogers and A. H. Thompson. Proc. 63rd An. Meet. of Md. Hort. Soc. pp. 1-3. January 5, 6, 1961.
- 437 The Shear-Press, A Basic Tool for the Food Technologist. Amihud Kramer. The Food Scientist 5(1):7-16. 1961.
- 462 Sweet Potato Sprout Production. W. A. Matthews and F. C. Stark. Trans. Penin. Hort. Soc. 51:40-42. 1961.
- A919 Yield, Fruit Size and Growth of York Imperial Apple Trees as Affected by Chemical Thinning and Differential Nitrogen Nutrition for Six Years. B. L. Rogers and A. H. Thompson. Proc. Amer. Soc. Hort. Sci. 80:50-57. 1962.
- A922 A Rapid Objective Method for the Estimation of Carotenoid Content in Sweet Potato Roots. E. M. Ahmed and L. E. Scott. Proc. Amer. Soc. Hort. Sci. 80:497-506. 1962.
- A926 Relation of Factors of Quality to Grade of Canned Tomatoes. Amihud Kramer, B. A. Twigg, Jane Cooler and F. W. Cooler. Food Tech. 16(1):30-32. January, 1962.
- A931 Firmness of Processed Sweet Potatoes (*Ipomoea batatas*) as Affected by Temperatures and Duration of the Post-Harvest Holding Period. R. A. Baumgardner and L. E. Scott. Proc. Amer. Soc. Hort. Sci. 80:507-514. 1962.
- A956 The Effects of Early Season Sprays of Boron on Fruit Set, Color, Finish, and Storage Life of Apples. W. J. Bramlage and A. H. Thompson. Proc. Amer. Soc. Hort. Sci. 80:64-72. 1962.

- A960 Application of the Accuracy Composition Analyzer to the Measurement of Density, Consistency and Caloric Value of Vegetables. E. M. Ahmed and Amihud Kramer. *Proc. Amer. Soc. Hort. Sci.* 81:493-497. 1962.
- A961 An Instrumental Method for Measuring Quality of Raw and Canned Sweet Corn. Amihud Kramer and Jane C. Cooler. *Proc. Amer. Soc. Hort. Sci.* 81:421-427. 1962.
- A964 Chemical Weed Control in Apple and Peach Orchards. B. L. Rogers. *Trans. Penin. Hort. Soc.* 51:53-61. 1961.
- A977 Effects of Heavy Annual Applications of Potassium on Red Delicious Apple Trees. J. A. Barden and A. H. Thompson. *Proc. Amer. Soc. Hort. Sci.* 81:18-25. 1962.
- A979 Liquid-Solids Separation, A Problem in Processed Applesauce. Verner Toldby and R. C. Wiley. *Proc. Amer. Soc. Hort. Sci.* 81:78-92. 1962.
- A982 The Utilization of Cytoplasmic Male Sterility for Sweet Corn Hybrid Seed Production. G. S. Johnston and R. J. Snyder. *Proc. Amer. Soc. Hort. Sci.* 81:415-420. 1962.

#### Department of Poultry Science

- 424 Interrelationships of Dietary Energy and Protein in Poultry Nutrition. Papers of the Univ. of Nottingham, England, 8th Easter School Digestive Physiol. and Nutr. of Pigs and Poultry. G. F. Combs. 21 pp. 1962.
- 442 Area Comparisons—Broiler Processing and Marketing. N. V. Helbacka, H. D. Smith and J. L. Casterline, Jr. Multigraphed Circular. 44 pp. November, 1961.
- 449 The Failure of Supplementary Vitamins to Stimulate Poult Growth When Added to Practical Poult Diets. R. D. Creek, B. Panda, C. S. Shaffner and G. F. Combs. *Feedstuffs* 34(24):32. June 16, 1962.
- 454 Can Wheat By-Products be Processed? R. D. Creek. *Feedstuffs* 34(16):38-58. April 21, 1962.
- A901 The Carbohydrate Metabolism of Chicken Semen. G. C. Harris, Jr., and F. H. Wilcox. *Poultry Sci.* XLI(2):410-416. March, 1962.
- A916 Steroid Requirements of Trichomonads. Pauline G. Lund and Mary S. Shorb. *Jour. Protozool.* 9(2):151-154. May, 1962.
- A917 Serum Alkaline Phosphatase and Egg Production. F. H. Wilcox, L. D. VanVleck and C. S. Shaffner. *Proc. 12th World's Poultry Congress.* pp. 19-22. August, 1962.
- A930 Secretion of Androgen by the Ovary of the Laying Pullets. B. Panda. *Indian Vet. Jour.* 38(10):481-487. October, 1961.
- A933 The Influence of Fast and Slow Drops in Ambient Temperature on Egg Production Traits. A. C. Campos, F. H. Wilcox and C. S. Shaffner. *Poultry Sci.* XLI(3):856-865. May, 1962.
- A935 Evidence for the Presence of a Thermolabile Growth Inhibitor in Raw Wheat Germ. R. D. Creek, Valeria Vasaitis, W. O. Pollard and George Schumaier. *Poultry Sci.* XLI(3):901-904. May, 1962.
- A936 Changes in Albumen Quality with Time. F. H. Wilcox and H. R. Wilson. *Poultry Sci.* XLI(3):883-886. May, 1962.
- A942 Genetic Differences in Serum Cholesterol in Chickens. L. B. Hardy, H. V. Auger and F. H. Wilcox. *Amer. Jour. Physiol.* 202(5):997-1001. May, 1962.
- A943 Genetics and Disease Resistance in Animals—A Review. B. Panda. *Indian Vet. Jour.* 38(12):577-591. December, 1961.
- A947 Semen Dilution During Storage and Washing. F. H. Wilcox and R. G. Clark. *Poultry Sci.* 41(4):1091-1096. July, 1962.
- A970 Isolation of an Anti-Proteolytic Substance from Raw Wheat Germ. R. D. Creek and Valeria Vasaitis. *Poultry Sci.* 41(4):1351-1352. July, 1962.

Department of Veterinary Science

- A903 Preliminary Report on a New Technique for Isolation of *Vibrio-Fetus* from Carrier Bulls. G. J. Plumer, W. C. Duvall and Virginia M. Shepler. Cornell Vet. 52(1):110-131. January, 1962.
- A912 Observations of Eastern Equine Encephalitis in Maryland in 1959. R. J. Byrne, F. M. Hetrick, J. E. Scanlon, J. W. Hastings and L. N. Locke. Jour. Amer. Vet. Med. Assoc. 139(6):661-664. September 15, 1961.
- A920 A Serological Analysis of Eight Strains of *Mycoplasma gallinarum*. J. K. Noel, H. M. DeVolt and J. E. Faber. Poultry Sci. XLI(2):580-587. March, 1962.
- A925 Biochemical and Colonial Characteristics of Some Bovine Vibrios. S. B. Mohanty, G. J. Plumer and J. E. Faber. Amer. Jour. Vet. Res. 23(94):554-557. May, 1962.

# CURRENT PROJECTS

*(These are projects and not publications available to the public)*

## Department of Agricultural Economics

- A-18-am An Analysis of Alternative Adjustments in Farm Organization. Sidney Ishee.
- A-18-an An Economic Analysis of Cage and Floor Methods of Commercial Egg Production. R. A. Murray.
- A-18-ao An Analysis of Forage Storage on Dairy Farms. J. W. Wysong.
- A-18-ap Economic Profitability of Vegetable Production in Maryland. Sidney Ishee and J. M. Curtis.
- A-18-aq Economic Effects of Vertical Integration on the Production and Marketing of Maryland Farm Products. Sidney Ishee.
- A-18-ar Economies of Scale in the Production of Fluid Milk or Specialized Dairy Farms in Maryland. J. W. Wysong and Paxton Marshall.
- A-18-as An Analysis of Past, Present and Prospective Levels and Variability of Prices of Maryland Farm Products and Farm Resources. J. W. Wysong.
- A-18-at The Acquisition and Use of Capital on Large Farms in Selected Type-of-Farming Area in Maryland. R. A. Murray.
- A-18-au Dairy Adjustments and Supply Response in Maryland and the Northeast. J. W. Wysong, Paxton Marshall and G. E. Frick.
- A-19-w Comparison of Tax Resources, Efforts and Sacrifices Among Counties in Supporting County Functions in Maryland. W. P. Walker.
- A-19-y Assessment and Taxation of Farmland in the Rural-Urban Fringe in Maryland. F. D. Stocker, Peter House and W. P. Walker.
- A-26-az An Economic Analysis of Soybean Marketing in Maryland. Clifford Taylor and Bhagwant Singh.
- A-26-ba Sales Organizational Aspects of Quality Control in the Marketing of Processed Fruits and Vegetables. D. A. Swope, F. R. Todd, P. F. Brown, L. C. O'Day, J. M. Curtis and J. E. Martin.
- A-26-bb Impact of Recent Trends in Specification Production and Buying of Livestock on Market Organization and Services. H. D. Smith and J. N. Smith.
- A-26-bc Adjustments of Maryland Milk Processing-Distribution Systems and Practices to Changing Condition. G. M. Beal and Yedla Rao.
- A-26-bd Adjustments in Broiler Industry Related to Area Competition and Market Demand. H. D. Smith, J. E. Martin and J. E. Curtis.
- A-26-bf Improving Auction Warehouse Facilities and Methods of Marketing Maryland Tobacco. G. M. Beal and R. M. Jones.
- A-26-bg Analysis of the Impact of Farmer Cooperatives on the Agricultural Economy in Maryland. R. J. Beiter.
- QA-58-s Effects of Alternative Vining Methods on Processing Cost and Quality of Lima Beans. (Coop. Department of Horticulture) D. A. Swope, B. A. Twigg, Ray Fox and L. C. O'Day.

## Department of Agricultural and Extension Education

- T-6 Identification of High School Educational Experiences Affecting the Success of Students in the College of Agriculture. C. R. Smith.
- T-8 A Study of First Year 4-H Club Leaders in Maryland. C. R. Smith and E. C. Joseph.

## Department of Agricultural Engineering

- R-11-f Mechanization of Tobacco Harvest. P. N. Winn, Jr., G. L. Burkhardt, R. L. Green, E. W. Martin, N. Martin, J. H. Hoyert and J. Berlijn.
- R-16 Pneumatic Handling of Chopped Forage. W. L. Harris, G. J. Burkhardt, K. E. Felton, R. L. Green, E. W. Martin and J. E. Foster.

- R-18 Development of Equipment and Improved Methods for Harvesting Sweet Potatoes. G. J. Burkhardt, L. E. Scott, E. W. Martin and K. E. Felton.
- R-20 Principles of Separating Crop from Soil in Harvesting Root Crops. G. J. Burkhardt.
- R-21 Development and Construction of Specialized Facilities and Equipment for Use in Agricultural Research. G. J. Burkhardt, W. C. Schaefer, E. W. Martin, R. W. Krauss, E. M. Ahmend, J. D. Rigglesman, H. S. Todd and W. W. Green.
- RB-11-g Tobacco Housing. (Coop. Department of Agronomy) O. E. Street, J. Hoyert, P. N. Winn, Jr., G. J. Burkhardt, R. L. Green, E. W. Martin, and N. Martin.

#### Department of Agronomy

- B-43 Soybean Varietal Improvement. R. C. Leffel and C. E. Bass.
- B-50 Breeding for Better Dent Corn. R. G. Rothgeb and N. A. Clark.
- B-56-g Ladino Clover Breeding, Disease and Insect Investigations. R. C. Leffel.
- B-56-i Breeding and Evaluation of Improvement Varieties of Orchard Grass and Other Forage Crops. R. C. Leffel.
- B-56-j Pasture Species for Beef Production. A. M. Decker and J. E. Foster.
- B-66 Wheat Breeding and Evaluation. R. G. Rothgeb, J. L. Newcomer and J. H. Axley.
- B-67 Varietal Improvement in Barley and Oats. R. G. Rothgeb and assistants.
- B-68 Effects of Rotational Practices Involving Various Legumes on the Growth, Quality and Composition of Maryland Tobacco. C. G. McKee, J. H. Mills, John Hoyert, O. E. Street, J. D. Bowling and J. E. McMurtrey, Jr.
- B-70 A Study of the Growth Characteristics of Foxtail (*Setaria* spp.) as Related to Chemical Control Measures. P. W. Santelmann and J. A. Meade.
- B-72 Evaluation of Varietal Purity and Identity of Seeds of Improved Strains of Alfalfa. J. L. Newcomer.
- B-73 Clipping Management Effects on the Productivity and Persistence of Perennial Grasses Under Two Nitrogen Levels. A. M. Decker, N. A. Clark and J. T. Raese.
- B-74 The Effects of Nitrogen Rates and Clipping Frequency on the Performance of Midland Bermudagrass (*Cynodon dactylon* (L) Pers.). A. M. Decker.
- B-75 Use of Sod-seeded Forage Crops to Supplement Existing Permanent Pastures. A. M. Decker, F. G. Swain, W. C. Hulbert and A. L. Steinhauer.
- B-76 Red Clover Breeding Investigations. R. C. Leffel.
- B-77 Forage Crop Variety Evaluation in Maryland. R. C. Leffel, A. M. Decker and N. A. Clark.
- B-78 The Control of Weeds in Cultivated Crops, Turf and Brush. J. A. Meade, N. C. Glaze and R. D. Koontz.
- B-79 Use of Herbicides to Control Weeds in Forages. J. A. Meade and P. W. Santelmann.
- B-80 Physiological and Ecological Investigations on the Effect of the Herbicides on Plants. J. A. Meade.
- B-81 Preplant Herbicides for Tobacco Plant Beds and their Influence on Seedling Production. O. E. Street, C. G. McKee, J. D. Bowling, J. E. McMurtrey, Jr., and J. H. Hoyert.
- B-82 Fertility and Clipping Management Effects on the Productivity and Persistence of Annual Pasture Grasses. N. A. Clark.
- B-83 Forage Crop Development Under Controlled Soil Temperature Conditions. A. M. Decker and N. H. MacLeod.
- B-85 Late Planting and Winter Survival in Oats. R. G. Rothgeb and assistants.
- B-86 A Comparison of Silage Corn Grown Under High and Low Rates of Nitrogen When Fed to Milking Cows. N. A. Clark.
- B-87 Factors Contributing to Maximum Production in Maryland Tobacco. O. E. Street, J. H. Hoyert, J. D. Bowling, J. E. McMurtrey, Jr., and Thomas Thies.
- B-89 Studies of Some Fundamental Physiochemical Relationships of Tobacco With Respect to Cultural, Fertilization, Curing and Fermentation Practices. P. N. Winn, G. J. Burkhardt, R. L. Green, O. E. Street, R. G. Rothgeb, D. D. Tyrer, R. N. Jeffry and Thomas Thies.



- B-93 Response of Midland Bermudagrass to Urea and Ammonium Nitrate Applied at Different Times and Rates. A. M. Decker and J. R. Miller.
- B-94 The Effects of Physical Characteristics of Herbicides on Efficiency and Mode of Action When Used on Corn and Soybeans. P. W. Santelmann, J. A. Meade, N. C. Glaze and R. Koontz.
- BG-2 Grazing Study with Lactating Dairy Cows on Summer Annual Pastures. (Coop. with Department of Dairy Science). N. A. Clark, R. W. Hemken and J. H. Vandersall.
- BQ-83 Yield and Quality of Selected Crops Receiving Supplemental Irrigation, Including Relationships of Moisture to Species, Fertilizers and Cultural Practices. A. M. Decker, Jr., Edward Strickling, O. E. Street, C. W. Reynolds and F. C. Stark. (Coop. Department of Horticulture)
- BOQR-84 Climatological Relationship to Plant Growth. (Coop. Depts. of Agrl. Engineering and Horticulture) O. E. Street, A. M. Decker, Edward Strickling, C. W. Reynolds, P. N. Winn, R. L. Green, H. E. Heggsted, H. A. Menser, A. D. Patterson and J. K. McGuire.
- O-48 Morphologic Studies of Maryland Soils as Related to Classification and Correlation. J. A. Pomeroy and W. F. Sledjeski.
- O-54 Clay and Secondary Mineral Genesis in Maryland Soils. G. A. Bourbeau, Fay Yee and Hsin Yuan Tu.
- O-55 Soil Test Studies. J. H. Axley, Clifford Simonson, Mike Peach, C. W. Whitaker, Albert Hunter, Joseph Steckel and Harlem Kenny.
- O-56 Factors Affecting the Formation and Destruction of Soil Aggregates. Edward Strickling and G. Malley.
- O-57 A Study of Ammonium as a Fertilizer and Ammonium Retention in Soils. John Axley.
- O-59 Response of Orchardgrass to Various Rates and Ratios of Potassium and Nitrogen Fertilization. C. B. Kresge.
- O-62 The Response of Forages and Certain Grain Crops to Fertilizers as Related to Rates and Ratios and Methods of Application. John Axley and Maurice Freere.
- O-63 Response of Orchardgrass to Various Sources of Nitrogen and their Time of Application. C. B. Kresge.
- O-64 Response of Bermudagrass to Various Rates and Ratios of Potassium and Nitrogen Fertilization. C. B. Kresge, A. M. Decker and N. A. Clark.
- O-65 Legume Grass Mixtures in Relation to Differential Nitrogen Fertilization. C. B. Kresge.

#### Department of Animal Science

- 2-21 The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel.
- 2-25-a The Effects of Roughage Preparation. E. C. Leffel, L. W. Smith and B. Mahapatra.
- 2-31-a Comparison of Pelleted versus Unpelleted Barley for Feeding Weaned Beef Calves. John Buric, J. E. Foster and E. C. Leffel.
- 2-31-b Comparison of Morea versus Oil Meal as a Supplement for Feeding Weaned Beef Calves. John Buric, J. E. Foster and E. C. Leffel.
- 2-33 A Study of the Effect of Menhaden Fish Meal on the Quality of Protein of Swine Diets and on Total Crude Protein Requirements for Growth of Swine. E. P. Young, J. E. Foster, D. G. Snyder and R. R. Kifer.
- 2-34 A Study of the Nutritional and Physiological Influences on Variability of Ovulation Rate and Embryonic Survival in Swine. E. P. Young, W. W. Green and J. E. Foster.
- 2-35 Studies on the Efficiency and Composition of Growth in Swine as Affected by Protein and Energy Consumption. G. F. Combs, E. P. Young, E. C. Leffel and J. E. Foster.
- 2-36 A Study of Factors Affecting the Utilization of Non-protein Nitrogen in High Roughage Diets for Ruminants. E. C. Leffel and N. Satapathy.

- C-37 A Comparison of Different Roughage-Grain Ratios for Optimum Gains for Developing Weanling Beef Heifers. John Buric, J. E. Foster and E. C. Leffel.
- C-38 A Study of Factors that Influence Feed Consumption by Suckling Pigs. E. P. Young and J. E. Foster.
- C-39 Analyses of Records of Beef Cattle Herds in Maryland. W. W. Green, J. E. Foster, and J. B. Lingle.
- C-40 A Study of the Use of Measurements for the Evaluation of Beef Breeding Cattle. W. W. Green, John Buric, J. E. Foster and J. L. Carmon.
- C-41 A Study of Variations in Values of Criteria Used in Selection Indices for Beef Cattle. John Buric, J. E. Foster and W. W. Green.
- C-42 A Study of Rates of Ruminant Digestion and Absorption from the Rumen. E. C. Leffel, N. Satapathy, J. Barth and R. J. Komarek.

#### Department of Botany

- F-12 The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown and M. L. Brown.
- F-17 Forest Tree Improvement by Chromosome Doubling of Haploid Sporophytes. R. D. Rappleye.
- F-18 Genetic Control of the First Division Association of Homologous Chromosomes and Fertility in *Zea mays* and *Capsicum frutescens*. D. T. Morgan, Jr., R. D. Rappleye and R. L. Baker.
- J-91 Fungicidal Materials on Cellular Metabolism and Their Usefulness for the Field Control of Vegetable Diseases. H. D. Sisler, R. A. Paterson, A. A. Bell, J. G. Kantzes and graduate assistants.
- J-93 Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, J. G. Kantzes, L. R. Krusberg, A. A. Bell, J. B. Wilson and R. C. Leffel.
- J-95 Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, O. E. Street, John Hoyert and D. Haggstedt.
- J-97 Physiology of Plant Parasitic Nematodes and the Plant Nematode Interaction. L. R. Krusberg, R. F. Myers and R. K. Howell.
- J-98 Identification, Characterization and Control of Certain Viruses Affecting Economic Plants in Maryland. H. D. Sisler and O. D. Morgan.
- J-99 The Nature and Control of Root Rots Involved in Decline of Boxwood and Other Woody Ornamental Plants in Maryland. J. B. Wilson and L. R. Krusberg.
- J-100 Nature and Control of Major Field and Storage Diseases of Sweet Potatoes in Maryland. J. G. Kantzes and John Wells.
- K-8-c Biophysical and Biochemical Factors in Plant Nutrition. H. G. Gauch, R. W. Krauss, Raymond Galloway, Lois Carleton, John Bowen and Milton Chamberlain.

#### Department of Dairy Science

- G-34 Chemical Changes in Milk Fat as Related to the Flavor of the Milk. R. I. King and Mark Kenney.
- G-35 The Analysis of Dairy Products. Mark Kenney, Ira Katz, R. L. King, J. I. Mattick and J. F. Kunsman.
- G-37 Physiology of Metabolic Diseases of Cattle. W. F. Williams, R. W. Hemken, S. D. Lee, H. H. Head and J. D. Connolly.
- G-38 The Endocrine Regulation of Glucogenesis and Glucose Metabolism as Related to Milk Secretion. W. F. Williams, R. F. David, H. H. Head and J. I. Connolly.
- G-39 Studies on the Mode of Digestion, Absorption and Utilization of Feeds by Ruminants and their Associated Bacteria. W. E. Stewart, R. N. Doetsch, P. J. Provost and R. F. Davis.
- G-40 Influence of High Temperature Heat Treatment on Certain Physical and Chemical Properties of Milk. J. F. Mattick, R. L. King and Mark Keener.

- G-42 Methods of Processing and Other Factors Affecting the Quality of Ice Cream. W. S. Arbuckle.
- G-46 The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproduction and Milk Production. W. F. Williams, S. D. Lee and J. D. Connolly.
- G-47 The Nutritive Evaluation of Forages. R. W. Hemken, N. A. Clark, R. F. Davis and D. T. Buchman.
- G-48 Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney and Ira Katz.
- G-50 The Physiology of Mammary Gland Growth and Development and the Initiation and Maintenance of Lactation with Particular Reference to Endocrine Relationships. W. F. Williams and G. D. Turner.
- G-51 A Study of the Effects of Pelleting and Heating of Feeds Upon Body Composition, Growth and Milk Secretion in Ruminants. J. H. Vandersall, R. W. Hemken and R. L. King.
- G-52 A Study of Factors Affecting the Voluntary Intake, Availability and Utilization of Nutrients in Forages for Growth and Milk Production. J. H. Vandersall, R. W. Hemken, N. A. Clark and R. F. Davis.
- G-53 A Study of the Development, Improvement or Standardization of Manufacturing Processes for the Production of Various Cheeses and the Effects of Specific Factors on the Flavor, Body and Texture of these Cheeses. J. F. Mattick.
- GC-45 Studies of the Physiological and Biochemical Nature of Bloat. W. E. Stewart, E. C. Leffel, R. J. Komarek, B. Mahapatra, J. E. Foster, R. F. Davis and W. F. Williams.
- BG-1 The Comparison of Nitrogen Fertilized Grasses with a Grass Legume Mixture for Lactating Dairy Cows. N. A. Clark, A. M. Decker, R. W. Hemken, John I. Leslie and R. F. Davis.

#### Department of Entomology

- H-29-n Chemical Control of Insect Pests of Sweet Corn. L. P. Ditman and F. P. Harrison.
- H-46-e Continued Studies on the Efficiency of Fixed-Boom Low-Volume Sprayers and the Development of New Insecticides. L. P. Ditman, G. J. Burkhardt, W. E. Bickley and graduate students.
- H-48 Control of the Codling Moth and Careful Observations on Possibility of Resistant Strains. W. E. Bickley, Castillo Graham and E. R. Krestensen.
- H-56 Patuxent Projects on the Effect of Soil Conservation Upon Insect Populations. H. B. Owens, L. P. Ditman and W. E. Bickley.
- H-61 The Biology and Distribution of *Macropsis Trimaculata* Fitch. W. E. Bickley, Castillo Graham and E. R. Krestensen.
- H-64 An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.
- H-67 Insecticidal Residues on Vegetable and Forage Crops. L. P. Ditman and R. E. Menzer.
- H-69 Identification and Control of the Various Species of Mites Causing Damage to Apple Orchards. W. E. Bickley, Castillo Graham and E. R. Krestensen.
- H-71-d Alfalfa Insects, Their Biology and Control. A. L. Steinhauer.
- H-72 Physiology of Insect Reproduction. J. C. Jones and Elliott Krafur.
- H-73-a The Mosquito Fauna in Selected Swamps, Marshes and Impoundments. W. E. Bickley and graduate students.
- H-74 Biology and Control of Tobacco Insects. F. P. Harrison.
- H-76 Comparative Morphology and Physiology of Insect Blood Cells. J. C. Jones, Mrs. D. P. Liu, Ronald Wheeler and S. S. Kumar.
- H-77 The Susceptibility of the Red-Banded Leaf Roller *Argyrotaenia velutinana* (Wlkr.) to TDE. E. R. Krestensen, Castillo Graham and W. E. Bickley.
- H-78 Metabolism of Essential Nutrients and Insecticidal Chemicals in Insects. A. L. Steinhauer and graduate students.

- H-79 Classification of Green Lacewings (Chrysopidae: neuroptera). W. E. Bickley and R. A. Bram.
- H-80 Classification of the Neotropical Mosquitoes of the Subgenus *Culex*. W. E. Bickley and R. A. Bram.

#### Department of Home Economics

- Y-1 The Effect of Different Quality and/or Quantities of Dietary Protein on Serum Lipid Levels. Pela Braucher, L. M. Dyke, Virginia Dawson, Genevieve Watkins, E. C. Cox and C. M. Johnson.
- Y-2 Measurements of Air Permeability on Selected Garment Fabrics Before and With Wear. T. Faye Mitchell and Eleanor Young.

#### Department of Horticulture

- I-74-a Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Potted Plants. J. B. Shanks, C. B. Link and LeMoyné Hogan.
- I-74-b Effects of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. C. B. Link and J. B. Shanks.
- I-79-k Factors Influencing the Induction, Formation and Development of the Inflorescence in *Hydrangea macrophylla* (Thunb.) J. B. Shanks, C. B. Link and P. L. Smeal.
- I-79-1 Physiological Differences of Winter and Summer Flowering Varieties of Snapdragons as Related to Growth and Flower Quality. C. B. Link, J. B. Shanks and Kenneth Sanderson.
- L-74 Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, B. L. Rogers, L. E. Scott, F. J. Lawrence, I. C. Haut and S. H. Todd.
- L-74-b Chemical Thinning of Apples and Peaches. A. H. Thompson and B. L. Rogers.
- L-74-c Boron Nutrition of the Apple in Relation to the Development of Bitter Pit and of Red Color and Finish. A. H. Thompson, A. A. Hewitt, H. J. Bramlage, B. L. Rogers and H. G. Gauch.
- L-79-a Relation of the Level of Mineral Nutrients in the Plant to Growth and Fruiting of the Strawberry with Particular Reference to Nitrogen. L. E. Scott, G. J. Stadelbacher, W. A. Matthews and I. C. Haut.
- L-79-d Mineral Nutrition of the Apple with Reference to Growth, Fruitfulness and the Development of Internal Bark Necrosis. A. H. Thompson, L. E. Scott, B. L. Rogers and J. A. Barden.
- Q-58-a Rapid Nutritive Evaluation of Processed Vegetables. Amihud Kramer, L. E. Scott and E. M. Ahmed.
- Q-58-f Development of Objective Grades and Standards and Quality Control Method for Vegetables. Amihud Kramer, B. A. Twigg, R. C. Wiley, E. Ahmed, F. W. Cooler and Jane Cooler.
- Q-58-m Development of New Products and Improved Processing Methods. R. C. Wiley, Amihud Kramer, B. A. Twigg, J. Cooler, M. Modery and T. Chase.
- Q-58-n Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, B. A. Twigg, Amihud Kramer, F. C. Stark and L. E. Scott.
- Q-58-p Quality Improvement of Canned Apple Slices and Sauce Through Studies of the Relation of Water Insoluble Constituents of the Fresh Fruit to the Textural Quality of the Processed Product. R. C. Wiley, A. H. Thompson, G. E. Stembridge, J. E. Collins and M. Modery.
- Q-58-q Bulk Packaging and Shipping of Raw Vegetables. Amihud Kramer, B. A. Twigg, R. C. Wiley, E. Ahmed, F. W. Cooler and Jane Cooler.
- Q-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, F. C. Stark, C. W. Reynolds, L. E. Scott, J. G. Kantzes and W. A. Matthews.
- Q-77 Crop Management Studies with Vegetable Crops. W. L. Hollis, F. C. Stark and C. W. Reynolds.

- Q-77-b Efficacy and Selectivity of Chemical Herbicides for Controlling Major Weed Species in Truck Crop Production. J. D. Riggleman, W. A. Matthews, G. J. Stadelbacher and F. C. Stark.
- Q-79-g Changes in Chemical Composition of the Sweet Potato During Development, Storage and Processing as Related to Quality of the Final Product. L. E. Scott, W. A. Matthews, R. A. Baumgardner and F. C. Stark.
- Q-79-h Influence of Nutrient Intensity and Balance on the Growth, Yield and Quality of Cauliflower. C. W. Reynolds, F. C. Stark and A. G. Alexander.
- Q-81 Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark and W. A. Matthews.
- Q-81-b Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Cracking. F. C. Stark, W. A. Matthews and L. E. Scott.
- Q-81-c Sweet Corn Breeding with Particular Reference to the Utilization of Cytoplasmic Male Sterility in the Production of F<sub>1</sub> Hybrid Seed Corn. R. J. Snyder and G. S. Johnston.
- Q-82 Tomato Breeding and Selection with Particular Reference to Greater Resistance to Cracking and to Late Blight. F. C. Stark, W. A. Matthews and B. D. Horton.
- QRA-1 The Retention of Market Quality of Sweet Potatoes by Improved Methods of Harvesting, Grading and Handling. (Coop. with Depts. of Agrl. Econ. & Agrl. Engr.) L. E. Scott, W. A. Matthews, H. S. Todd, G. J. Burkhardt, P. N. Winn, Harold Hoecker and Liden O'Day.

#### Department of Poultry Science

- M-32-1 Study of Factors Influencing or Controlling the On-Set of Molt. Mary Juhn, G. D. Quigley and C. S. Shaffner.
- M-32-m Genetic Differences in Alkaline Phosphatase Concentration of Blood Sera as Related to Differences in Egg Production and Egg Quality. F. H. Wilcox, C. S. Shaffner, H. V. Auger and H. R. Wilson.
- M-33-e Genetic Control of Serum Cholesterol Level. F. H. Wilcox, C. S. Shaffner and H. V. Auger.
- M-35-m Development of Improved Rations and Feeding Methods for Laying Chickens. G. F. Combs, Aaron Spandorf, G. R. Childs, F. H. Bossard and D. L. Blamberg.
- M-48 Microbiological Studies Pertaining to Poultry Nutrition. Mary S. Shorb, Pauline G. Lund and W. O. Pollard.
- M-49 Vitamin B<sub>12</sub> and Chick Nutrition. Mary S. Shorb, W. O. Pollard, Unabelle Blackwood and G. C. Harris.
- M-53 A Study of the Relationships Between High Ambient Temperature and the Shell Thickness of Market Eggs. N. V. Helbacka, C. Smith, C. S. Shaffner and J. L. Casterline.
- M-55 The Perception and Preference of Chickens for Different Colors. G. D. Quigley and Charles Coss.
- M-56 Effects of the Chicken Body Louse on Egg Production and Performance. G. D. Quigley.
- M-100 Quality Retention in Poultry Meats as Influenced by Methods of Processing. N. V. Helbacka, S. Patch, C. Smith, C. S. Shaffner and J. L. Casterline.
- M-200 Studies on Improved Broiler Nutrition. G. F. Combs and J. L. Nicholson.
- M-201 Vitamins and Unidentified Organic Factors in Poultry Nutrition. G. F. Combs, G. R. Childs, P. Panda, E. H. Bossard and D. L. Blamberg.
- M-202 Protein and Amino Acids in Poultry Nutrition. G. F. Combs, J. L. Nicholson, Aaron Spandorf, G. R. Childs, E. H. Bossard and D. L. Blamberg.
- M-203 Trace Minerals in Poultry Nutrition. W. C. Supplee, G. F. Combs, R. D. Creek, N. V. Helbacka and O. D. Keene.
- M-204 Nutrition and Bone Anomalies in Chicks and Turkeys. R. D. Creek, Valeria Vasaitis and W. O. Pollard.
- M-205 Mycotoxicoses as related to Poultry Nutrition and Various Unidentified Poultry Maladies. R. D. Creek, H. M. DeVolt, N. C. Laffer and G. Schumaier.
- M-301 Effect of Ambient Temperature on Efficiency of Broiler Production. C. S. Shaffner, P. N. Winn, Jr., J. L. Nicholson and J. L. Mulligan.

- M-302 Effect of Freezing and Reversible Inhibitors on Chicken Sperm, F. H. Wilcox, C. S. Shaffner, H. V. Auger and J. T. Parks.
- M-400 Effects of Protein Adequacy on the Efficiency of Selection for Early Fattening of Turkeys. C. S. Shaffner, G. F. Combs and G. D. Quigley.

#### Department of Veterinary Science

- D-52 Respiratory Disease of Poultry. H. M. DeVolt, S. B. Mohanty and A. P. Holst.
- D-57 Epizootiology of Equine Encephalitis in Maryland. R. J. Byrne, Frances S. Yancey and M. J. Collins.
- D-58 Infectious Bovine Mastitis. J. D. Kornder and G. M. Jones.
- D-59 An Investigation of "Air-Sac Infection" in Poultry. H. M. DeVolt, J. K. Noel and R. W. March.
- D-60 Investigations on Brucellosis of Cattle. Cornelia M. Cotton.
- D-61 A Study of Ruminant Metabolism with Emphasis Upon Its Relation to Ketosis. R. B. Johnson.
- D-62 Pathology of Breeding Failures in Cattle. R. J. Byrne, Frances Yancey and W. R. Anderson, G. J. Plumer and Virginia Shepler.
- D-63 Study of Bovine Respiratory Diseases. R. J. Byrne, S. C. Chang, G. J. Plumer and F. M. Hetrick.







In addition to state and federal funds, the research program of the University of Maryland Agricultural Experiment Station has received support during the year from many public, private and industrial organizations and individuals. It is regretted that space does not permit recognition of all sources of help, but the cooperation of all is herewith gratefully acknowledged.

UNIVERSITY OF MARYLAND  
AGRICULTURAL EXPERIMENT STATION

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.


The Bulletins and Reports of the Station will be mailed free of charge to all residents of the State who request them.

**University of Maryland**  
**AGRICULTURAL EXPERIMENT STATION**  
**College Park, Maryland**



ALL BOOKS IN THE BOOK ROOM  
UNIVERSITY OF MARYLAND LIBRARY  
COLLEGE PARK, MD.

DO NOT CIRCULATE

DO  CIRCULATE

